LABORATORY MANUAL OF PHARMACOLOGY

A.D.BUSH B.Sc.M.D.

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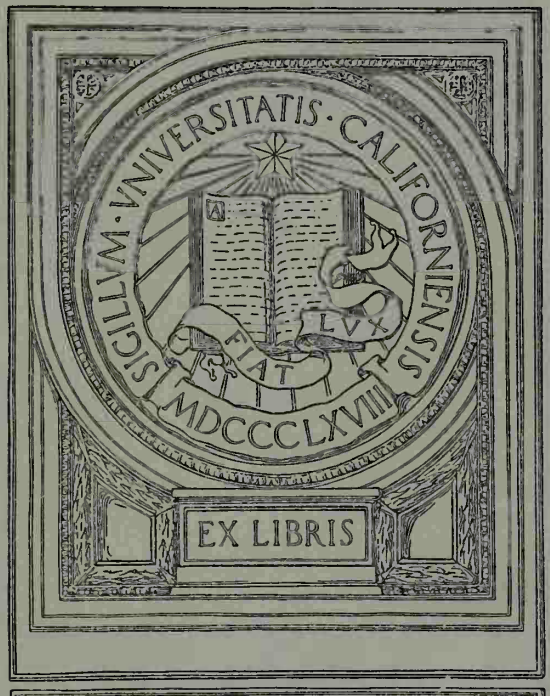

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LABORATORY MANUAL

OF

PHARMACOLOGY

INCLUDING

MATERIA MEDICA, PHARMACOPÆDICS

AND

PHARMACODYNAMICS

BY

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ILLUSTRATED WITH FULL-PAGE PLATES
MANY IN COLORS

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INTRODUCTION

THE fundamental reason for laboratory work in any subject, not entirely observational, is the training it gives in systematic observation. One of the best possible methods for developing adequate apprehension of the essentials of a problem is to require the student to record his observations in an orderly, systematic manner. To serve so valuable an end, this Manual is provided with definite leaders and spaces for recording the relatively more important data. The student thus works with directed purpose to discover important pharmacologic facts for himself.

To the possible objection that set formulæ might tend to cramp the student's powers of expression, it may be replied that these early years of a medical course represent a formative period in which should be developed accurate, systematic methods of observation; and such formulæ as prevent fruitless dissipation of energy thereby promote increased efficiency, both of thought and action.

This book has been prepared with the constant thought in mind that the great majority of medical students are not preparing to become specialists in Pharmacology, but practitioners of general medicine. Therefore the knowledge gained derives its chief value in proportion to its relation to medicine. The interests of the student are in such a case paramount to the interests of the specialist, though the difference in needs in the two cases is "less in matter and method than in proportion and emphasis." So, to paraphrase the words of an honored preceptor, Dr. Ganong, the real test of the value of this Manual will be found not in whether my colleagues deem it a well-proportioned compendium of pharmacologic fact, but whether it leads students to pursue the subject with an interested spirit, and to adopt spontaneously its methods and teachings in their later activities.

Materia Medica has always been a bugbear subject to most medical students, largely because of its dry, dictionary-like presentation. It is helpful to the student if he be given personal contact with the various drugs and preparations, with some clews as to their utilities, by way of introduction to the experimental and applied uses. This can be carried out very successfully in a laboratory, where the examination and testing of drugs is the means whereby he gains knowledge instead of information. If it be desirable for the medical student to know the physical properties and the principal

incompatibilities of drugs, then the best way to acquire such knowledge is by personal investigation.

In Pharmacodynamics, it is impossible for the students, through lack of time, to study many of the drugs experimentally; so an intensive study may well be made of the more important ones, especially those which produce registerable reactions. In such a study, a graded method is pedagogically superior. Hence the student is directed to first observe the way and manner in which simple tissue reacts to drug influence, for this purpose using the common frog. Next, he studies the reactions to that same drug of one of the mammals, like the cat, or rabbit, or dog. Then, because of sundry divergencies between the reactions of the lower animals and the higher, he tests this same drug on a human being—his fellow-student—gaining thereby also invaluable experience in observational methods. Next, inasmuch as thus far his information has not had that definite application necessary for conclusiveness, he makes further investigation of the Pharmacodynamics of that same drug at the hospital, in an attempt to learn how much and in what manner the toxins of disease may modify the apparent action of drugs. Finally, he checks up his accumulated observations by comparing them with the recorded observation of others, as presented in current literature. Thus the student acquires a training in method and procedure of inestimable value in his future work as a scientific physician.

A. D. BUSH.

INTRODUCTORY DEFINITIONS

PHARMACOLOGY is that science which treats of medicines.

Materia Medica is that branch of Pharmacology concerned with the origin and composition of drugs, together with their physical and chemical properties, and their dosage. Some brief reference to their therapeutic application is advisedly included.

Pharmacopædics is that branch of Pharmacology concerned with "the science of medicinal drugs and the art of their preparation." It is quite distinct from Pharmacy, which includes the collection, preservation, identification, compounding, and dispensing of drugs. Pharmacopædics deals with the various forms under which medicines are dispensed, together with their relative strengths, ingredients of compounds, relative availability and desirability. It is of much importance to the physician that he know the nature of the powerful tools he will later be called upon to use.

Pharmacodynamics is that branch of Pharmacology concerned with the manner in, and degree to which, living tissue reacts to drugs.

MATERIA MEDICA

In this section are presented for study the more important medicines official in the United States Pharmacopœia. The student is asked to note carefully the more important physical properties, and some of the principal chemical incompatibilities. At the same time he should take cognizance of the origin of the drug, its leading utilities, and the dose—not that he will necessarily be expected to remember all these details *en masse* at this time, but to make less arduous the ultimate acquirement of this related information.

Work should be performed in stated sequence, unless otherwise stipulated by the instructor. Findings should be written in, neatly and orderly, not only because neatness and orderliness are desirable virtues for their own sake, but because the student would also wish to have his part in writing this book a commendable one.

Besides the usual recommended texts and references, the following books may be further consulted, with profit as well as pleasure: U. S. Pharmacopœia, U. S. Dispensatory, Kraemer's Scientific and Applied Pharmacognosy, Remington's Pharmacy.

PART I.—MATERIA MEDICA.

ACACIA.

Acacia, or Gum Arabic, consists of the dried, gummy exudate from the stems and branches of *Acacia senegal* and other species of Acacia (Fam. *Leguminosæ*), trees indigenous to sandy soils in Central Africa.

Properties:

Form	Taste .....
Color	Solubility:
Feel	H_2O .....
Odor	C_2H_5OH .....

Keeping qualities (solution of Acacia):

One week	Two weeks	Four weeks
Appearance	Appearance	Appearance .....
Odor	Odor	Odor .....
Taste	Taste	Taste .....

Tests showing some incompatibilities (solution of Acacia):

NH_4OH	$Na_2B_4O_7$ .....
Lead Subac. T. S.	C_2H_5OH .....
$FeCl_3$ T. S.	Any tincture .....

Official Preparations.

Mucilago Acaciæ—Acacia, 350 Gm.; Aqua destillata, q. s. ad 1000 Gm.

Syrupus Acaciæ—Acacia, 100 Gm.; Sugar, 800 Gm.; Aqua destillata, q. s. ad 1000 Gm.

Therapeutics.—Acacia has no medicinal action other than as a protective for inflamed mucous surfaces, as in pharyngitis and gastritis. It is extensively used in pharmacy for its adhesiveness in the preparation of pills, lozenges and mixtures, and to aid in the emulsifying and holding in suspension of resins and oils.

ACETANILIDUM.

Acetanilid is made by treating aniline with glacial acetic acid in the presence of heat, with purification of the residue by sublimation and recrystallization.

Properties:

Form	Solubility:
Feel	Hot H_2O .....
Color	Cold H_2O .....
Odor	C_2H_5OH .....
Taste	

Tests showing some incompatibilities:

Triturate with Resorcinol	Con. KOH .....
Con. HNO_3	Tinct. Ferri Chloridi .....

Therapeutics.—Acetanilid has had wide use in the past as a sedative and analgesic, being used to lessen the pains of neuralgia and rheumatism, but it is rather dangerous through its depressant action on the heart; this untoward property also interferes with its utility as an antipyretic. Dose, 0.2 Gm.

Two closely related products are: *Acetphenetidinum* and *Antipyrina.* Dose of each, 0.3 Gm.

Properties:

Acetphenetidin:	Antipyrin:
Appearance	Appearance .....
Color	Color .....
Odor	Odor .....
Taste	Taste .....
Solubility:	Solubility:
H_2O	H_2O .....
C_2H_5OH	C_2H_5OH .....

Incompatibilities and therapeutic indications similar to Acetanilid; Acetphenetidin is probably less dangerous.

ACIDS USED AS MEDICINES.

Acidum Aceticum Dilutum. Prepared by mixing 12 parts of the official Acetic Acid with 61 parts of water. It should contain about 6 per cent. hydrogen acetate (CH_3COOH).

Properties:

Color ..... Odor ..... Taste .....

Titrate 25 mils, accurately weighed, with normal KOH, V.S., using phenolthalein as indicator. Each mil of titer corresponds to 0.06003 Gm. CH_3COOH.

How much of the titer did you use? .....

Then what strength is your sample of acid? .....

Dilute Acetic Acid is used principally as an antidote for caustic alkalies. Average dose, 2 mils.

Acidum Benzoicum ($C_6H_5.COOH$). An organic acid derived from the balsamic resin of styrax.

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	

Tests for leading incompatibilities:

Sol. Ac. Benzoic.:
Sol. $NaHCO_3$ .....
Dil. HCl .....

$FeCl_3$ T. S. .....
Quin. Bisulph. .....

Benzoic Acid is used in making paregoric.

In medicine Benzoic Acid may be used for undue alkalinity of the urine, or in treating phosphaturia. Average dose, 0.5 Gm.

Acidum Boricum (H_3BO_3). Derived from the borate of soda.

Properties:

Appearance .....
Color .....
Odor .....
Taste .....

Solubility:
H_2O .....
C_2H_5OH .....
$C_3H_5(OH)_3$ .....

Add $NaHCO_3$ T. S. to solution H_3BO_3. Result.....

Boric Acid is used in preparing the official Glyceritum Boroglycerini and Unguentum Acidi Borici.

The chief uses for Boric Acid are: a dusting powder in intertrigo, a valuable eye-wash (5% sol.) in conjunctivitis, a mild antiseptic in stomatitis, especially in infants.

Acidum Citricum ($C_6H_8O_7+H_2O$). An organic acid ordinarily obtained from the juice of lemons and limes.

Properties:

Appearance .....
Color .....
Odor .....
Taste .....

Solubility:
H_2O .....
C_2H_5OH .....

Treat solution Citric Acid with $NaHCO_3$, T. S. Result.....

Citric Acid is used in the preparation of Syrupus Acidi Citrici.

Citric Acid is used in the specific treatment of scorbutus, and in neutralizing acid urine. Average dose, 0.5 Gm.

Acidum Hydrochloricum Dilutum. Prepared by mixing 10 Gm. HCl with 22 Gm. distilled water.

Normal HCl being of 32% strength, of what strength is the official dilute acid?

.....

Properties:

Appearance .....
Color .....

Odor .....
Taste .....

Carefully weigh 2 Gm. dilute HCl, add 6 Gm. distilled water, and titrate the mixture with normal KOH, V. S., using methyl orange, T. S., as indicator.

How much titer did you use?.....

Each mil of the titer used corresponds with 0.03647 Gm. HCl.

Dilute Hydrochloric Acid, in 0.5% solution, is used in the treatment of hypochlorhydria.

Acidum Salicylicum ($C_7H_6O_3$). Orthohydroxybenzoic acid, obtained naturally from betula and gaultheria, but also made synthetically by treating phenol with sodium carbonate and carbon dioxide.

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	

Leading tests for incompatibilities: Add a small crystal of salicylic acid to the following:

Spir. Ætheris Nitrosi	Sod. Phosph. .....
$FeCl_3$ T. S.	Citric Acid .....
Quin. Bisulph. T. S.	

Salicylic Acid is used principally in the treatment of acute rheumatism, though the salts of the acid are more frequently employed. Average dose, 0.75 Gm.

Acidum Tannicum ($HC_{14}H_9O_9$). Usually obtained from nutgalls; also widely found in many vegetable substances.

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	$C_3H_5(OH)_3$ .....

Incompatibility tests: Add Tannic Acid T. S. to the following:

Egg Albumin Sol.	$FeCl_3$ T. S. .....
Any alkaloid	Spir. Ætheris Nitrosi .....
$CuSO_4$ T. S.	Starch T. S. .....

Do not triturate Tannic Acid with potassium chlorate. Why?.....

The Glycerite, Troche, and Unguent are official preparations.

Tannic Acid is used for its local astringent effect; but the desired effect is better produced by using some substance, like kino for example, containing tannin.

ACONITUM NAPELLUS.

Acidum Tartaricum ($C_4H_6O_6$). Usually obtained from argol.

Properties:

Appearance .....
Color .....
Odor .....
Taste .....

Solubility:
H_2O .....
C_2H_5OH .....

Dissolve 3 Gm. Tartaric Acid in 50 Gm. distilled water. Titrate with normal KOH, V. S., using phenolthalein as indicator. Each mil of titer indicates 0.07503 Gm. $C_4H_6O_6$.

Tartaric Acid is used in the preparation of the official Seidlitz Powder (Pulvis Effervescens Compositus). It has very little medicinal utility otherwise.

Other official acids of less or no therapeutic importance are: Acidum Aceticum, A. Aceticum Glaciale, A. Gallicum, A. Hydriodicum Dilutum, A. Hydrochloricum, A. Hydrocyanicum Dilutum, A. Hypophosphorosum, A. Hypophosphorosum Dilutum, A. Lacticum, A. Nitricum, A. Nitrohydrochloricum, A. Nitrohydrochloricum Dilutum, A. Oleicum, A. Phenylcinchoninicum, A. Phosphoricum, A. Phosphoricum Dilutum, A. Stearicum, A. Sulphuricum, A. Sulphuricum Aromaticum, A. Sulphuricum Dilutum, A. Trichloraceticum.

ACONITUM.

Aconite, or Monkshood, as it appears in commerce, is the dried, tuberous root of *Aconitus Napellus* (Fam. *Ranunculaceæ*), a perennial herb about 1 metre high, growing in mountainous regions of Europe, Asia, and North America.

Properties: (a) Root:

Appearance .....
Color .....
Cross-section .....

Odor .....
Taste (cautiously) .....

Properties: (b) Powder:

Color ..... Odor ..... Taste .....

Assay.—Place 15 Gm. No. 40 Aconite Powder in a flask, add 150 mils ether, shake well, then let it stand 10 minutes; add 5 mils NH_4OH, agitate vigorously every 10 minutes for 2 hours. Next add 15 mils distilled H_2O, shake well, let settle; then decant 100 mils of the solution, filtering it through purified cotton into a separator. Rinse funnel and cotton with a little ether. From this solution extract the alkaloid by repeated shakings out with weak H_2SO_4, collecting the acid washings in another separator; add NH_4OH to decided alkalinity (litmus test), and continue extraction, with repeated shakings out with ether. Evaporate the ether washings to dryness, dissolve the alkaloids in the residue in precisely 5 mils $\frac{N}{10}$ H_2SO_4, V. S., and titrate the excess of acid with $\frac{N}{50}$ KOH, V. S., using T.S. cochineal as indicator. Each mil $\frac{N}{10}$ H_2SO_4, V. S., consumed corresponds to 64.539 mg. of the ether-soluble alkaloids of Aconite.

What is the alkaloidal strength of your sample? .....

Official Preparations.

Extractum Aconiti—1.8% to 2.2% Aconitina. Average dose, 0.01 Gm.
Fluidextractum Aconiti—0.45% to 0.55% Aconitina. Average dose, 0.03 mil.
Tinctura Aconiti—0.045% to 0.055% Aconitina. Average dose, 0.3 mil.
Aconitina, the most poisonous of all alkaloids. Dose, 0.00015 Gm.

Therapeutics. Aconite is somewhat rarely indicated in sthenic types of acute inflammatory affections of the lungs or bronchi.

ADEPS.

Adeps, or Lard, is the purified internal fat taken from the abdomen of the hog (*Sus scrofa*).

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	$(C_2H_5)_2O$ .....
Melting Point	$CHCl_3$ .....

Prepare the official Adeps Benzoinatus by thoroughly mixing 0.1 Gm. coarsely powdered siam benzoin with 50 Gm. lard. Heat the mixture for 2 hours over a water bath at a temperature not exceeding 60° C., keeping container covered, but stirring the mixture frequently. Strain through muslin, and stir occasionally until it cools.

In separate dishes of equal diameter place an equal amount of lard and of benzoinated lard. Label and set aside on a shelf exposed to light and air. At each subsequent period examine for possible variations in physical properties.

Lard:	Benzoinated Lard
1 week	1 week .....
2 weeks	2 weeks .....
3 weeks	3 weeks .....
4 weeks	4 weeks .....

Adeps Lanæ, or Wool Fat, is a purified fat, freed from water, derived from the wool of sheep (*Ovis aries*).

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	$(C_2H_5)_2O$ .....
	$CHCl_3$ .....

Relative cohesiveness compared with Adeps.....
Relative absorbability compared with Adeps.....
Relative permanence in air compared with Adeps.....
Adeps Lanæ Hydrosus = Adeps Lanæ + about 28% water.
These several fats are used as bases for the preparation of ointments.

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ACONITE IN FLOWER (*Aconitum napellus*).

ÆTHER.

Ether is a highly inflammable liquid made by distilling and purifying a mixture of alcohol and sulphuric acid. It should contain at least 95.5% ethyl oxide $(C_2H_5)_2O$. Being highly inflammable it should be kept remote from any flame. Daylight causes a slow oxidation.

Properties:

Appearance .....
Color .....
Odor .....
Taste .....

Solubility, H_2O .....
Reaction .....
Specific Gravity .....

Volatility (note time for 5 mils poured on cloth to evaporate).....

The chief use for Ether is to produce anæsthesia.

Spiritus Ætheris is an official preparation.

ÆTHYLIS CARBAMAS.

Urethane is the ethyl ester of carbamic acid, obtained by treating a carbamide with ethyl alcohol. It should be kept in well-closed containers.

Properties:

Appearance .....
Color .....
Odor .....
Taste .....

Solubility:
H_2O .....
C_2H_5OH .....
$C_3H_5(OH)_3$ .....

Incompatibilities:

To a solution of Urethane add any alkali.....

Triturate Urethane with antipyrine, or camphor, chloral, menthol, phenol, salol, or salicylic acid .....

Alcoholic solution of Urethane + KOH produces crystals of KCN

Æthylis Carbamas is an hypnotic of uncertain reliability in man, but of considerable utility in laboratory work.

ÆTHYLIS CHLORIDUM.

Ethyl Chloride, or Monochlorethane, is prepared by treating absolute ethyl alcohol with hydrochloric acid gas. The product is very volatile, highly inflammable, and must be protected from light.

Spray some Ethyl Chloride in a fine, concentrated stream upon a small skin area.

What change takes place?.....

With a needle immediately test sensitiveness of spot. Result?.....

Ethyl Chloride is used to produce rapid local anæsthesia by freezing the skin. By inhalation it quickly produces profound sleep and a general anæsthesia, suitable for short operations.

ALCOHOL.

Alcohol (C_2H_5OH) is obtained by the distillation of a fermented amylaceous substance. The official Alcohol contains less than 8% by weight of water.

Properties:

Appearance	Volatility .....
Color	Inflammability .....
Odor	Miscibility, H_2O .....
Taste	

Incompatibilities: Mix Alcohol with

Albumin, T. S. ..... $HgCl_2$, T. S. ..... K_2MnO_4, T. S. .....

Alcohol is an excellent preservative, a good antiferment, and a fair antiseptic. Its use internally has been largely abandoned, owing to its toxicity, and to its possessing no definite physiological indications.

Two other alcohols are official:

Alcohol Dehydratum, containing not more than 1% H_2O by weight.

Alcohol Dilutum, containing about 51% H_2O by volume.

ALOE.

Aloes is the inspissated juice obtained from the leaves of several species of Aloe, a West Indies plant of the family *Liliaceæ*. Three varieties are found in commerce: the Socatrine, the Curaçao, and the Cape.

Properties of the..... variety:

Appearance	Taste .....
Color	Solubility, H_2O .....
Odor	Color of Solution .....

Consult U. S. P. IX. to determine source of your sample.

Aloinum is an active principle derived from Aloes. Dose, 0.015 Gm.

Aloes is a rather sharp purgative, acting chiefly on the distal portion of the large bowel. Average dose, 0.25 Gm.; this will cause severe griping in a susceptible individual.

Aloes is an ingredient in each of the following official preparations: Pilulæ Aloes, Pilulæ Rhei Compositæ, Tinctura Aloes, and Tinctura Benzoini Composita.

ALUMEN EXSICCATUM.

Burnt Alum is prepared by subjecting ammonium alum or potassium alum to a temperature not exceeding 200° C., until the water of crystallization has been expelled. When recently prepared it should contain not less than 96.5% $AlNH_4$ (or K) $(SO_4)_2$.

Properties:

Appearance	Solubility:
Color	Cold H_2O .....
Odor	Hot H_2O .....
Taste	C_2H_5OH .....

Incompatibilities: To alum solution add solution of

NaOH	Pb. Acet.
$Na_2B_4O_7$	$Ca(OH)_2$
$NaHCO_3$	$HgCl_2$
Ac. Gall.	Ac. Tart.

Alum is a mild cauterant, an irritant astringent, and a styptic.

AMMONIUM.

Of the seven official salts of Ammonium two only have the characteristic ion action. These are the Carbonate and Chloride.

Ammonium Carbonate is a varying mixture of acid ammonium carbonate and ammonium carbamate. It is prepared by subliming a mixture of calcium carbonate and ammonium sulphate.

Properties:

Appearance	Solubility:
Color	H_2O
Odor	C_2H_5OH
Taste	Effect of hot H_2O
Effect of exposure to air	

Incompatibilities: To Ammonium Carbonate T. S. add

Any acid solution	Any iron solution

The chief utility of Ammonium Carbonate is to irritate the terminals of the trigeminus when the ammonia gas therefrom is inhaled.

The Carbonate is used in preparing Spiritus Ammonii Aromaticus.

Ammonium Chloride is a purified product of the crude chloride resulting from treating gas liquor with hydrochloric acid.

Properties:

Appearance	Solubility:
Color	H_2O
Odor	C_2H_5OH
Taste	
Effect of exposure to moist air	

Incompatibilities: To Ammonium Chloride, T. S., add

$AgNO_3$, T. S.	Na_2CO_3, T. S.
NaOH, T. S.	An acid

Ammonium Chloride seems to have a beneficial effect on the type of sub-acute gastritis due to passive hepatic congestion.

Average dose, 0.3 Gm. Administered in the nascent vapor state, it is used for bronchitis.

An official preparation is Trochisci Ammonii Chloridi.

Official Preparations.

Ammonium Benzoate; dose, 1 Gm. Ammonium Bromide; dose, 1 Gm. Ammonium Iodide; dose, 0.3 Gm. Ammonium Salicylate; dose, 1 Gm. Ammonium Valerate; dose, 0.5 Gm.

The Bromide, Iodide, and Salicylate are generally considered inferior to the corresponding salts of sodium. The Benzoate is little used, while the Valerate is practically inert.

ANTIMONII ET POTASSII TARTRAS.

Tartar Emetic is made by suitably combining potassium bitartrate with the oxide of antimony.

Properties:

Appearance	Odor .....
Color	Taste .....

Tartar Emetic used to be extensively employed as a nauseant and emetic, but fortunately its use has been practically abandoned.

ARGENTI NITRAS.

Silver Nitrate ($AgNO_3$) is prepared by treating pure silver with pure diluted nitric acid, with crystallization. The salt should be kept in dark, amber-colored bottles, away from light.

Properties:

Appearance	Solubility:
Color	Cold H_2O .....
Odor	Hot H_2O .....
Taste (cautiously)	C_2H_5OH .....

Evaporate a drop of the aqueous solution on the hand .....

Evaporate another drop on a porcelain dish .....

Incompatibilities: Practically everything.

Silver Nitrate is an efficient prophylactic for ophthalmia neonatorum, 1 drop of a 1% solution being placed in each eye of the newly-born infant. It is of great service in the purulent conjunctivitis of adults. In general local application it is an efficient germicide; caustic in stronger solutions. Internally, it is somewhat rarely used in low forms of gastritis and in gastric ulcer. Dose, 0.01 Gm.

Other official salts of Silver are: Argenti nitras fusus, containing 94.5% $AgNO_3$ (lunar caustic); argenti oxidum, an unequal substitute for the nitrate.

ARSENI TRIOXIDUM.

White Arsenic, or Arsenous Acid, is a sublimation product obtained by roasting arsenical ores.

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Do not taste	$C_3H_5(OH)_3$ .....
	HCl .....

What is the Marsh test for the identification of Arsenic?.....

Incompatibilities: To Arsenous Acid, T. S., add

$FeCl_3$, T. S.	$AgNO_3$, T. S. .....
KI, T. S.	Ac. Tannic .....
$MgSO_4$, T. S.	

The principal utility of Arsenous Acid is for chorea. Dose, 0.0006 Gm. An unofficial salt, arsenobenzol or salvarsan, containing about 35% arsenic, is extensively used in the treatment of syphilis, relapsing fever, and frambesia or yaws. The dose is about 0.4 Gm., intramuscularly.

Official preparations made from White Arsenic:

Liquor Acidi Arsenosi. Dose, 0.2 mil.

Liquor Potassii Arsenitis (Fowler's Solution). Dose, 0.2 mil.

Other official preparations of Arsenic are: Sodii Arsenas; dose, 0.005 Gm. Sodii Arsenas Exsiccatus; dose, 0.003 Gm. Liquor Sodii Arsenatis; dose, 0.2 mil. Arseni Iodidum; dose, 0.005 Gm. This last salt combines the action of Arsenic and Iodine. The others have the characteristic action of Arsenic.

BALSAMUM PERUVIANUM.

Balsam of Peru is an exudate from the bruised trunk of *Toluifera Pereiræ* (Fam. *Leguminosæ*), a tree of Central America.

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	$CHCl_3$ .....

Balsam of Peru is used chiefly as a stimulant to granulations.

BELLADONNÆ FOLIA—BELLADONNÆ RADIX.

In use in medicine are a number of preparations made from the leaves and roots of *Atropa Belladonna* (Fam. *Solanaceæ*), a bushy perennial, native of Eurasia, but cultivated in northern temperate zones generally. The leaves yield about 0.3% of mydriatic alkaloids, and the root yields about 0.45%.

Compare Properties of powdered leaf and powdered root:

Leaf:	Root:
Appearance	Appearance .....
Color	Color .....
Odor	Odor .....
Taste	Taste .....

Assay of powdered Belladonna Root.—In a flask place 15 Gm. Belladonna Root, No. 60 powder; add 50 mils chloroform and 100 mils ether; shake vigorously, and then let it stand about 10 minutes. Add 5 mils NH_4OH, and agitate every 10 minutes for the next 2 hours. Next add 15 mils distilled H_2O; shake mixture well, let settle, then decant 100 mils and filter it through purified cotton into a separatory funnel, adding ether rinsings from graduate and expressed cotton. The alkaloids in solution may now be extracted by repeated shakings out of the solution with weak sulphuric acid. Place acid washings in a separator, add NH_4OH until solution is plainly alkaline (litmus); then repeatedly shake out with chloroform, which will again extract the alkaloids. Now exaporate all the chloroform from the washings, carefully dry, then dissolve the residue in *exactly* 5 mils $\frac{N}{10}$ H_2SO_4 V. S., titrate the excess acid with $\frac{N}{50}$ KOH, V. S., using for indicator cochineal T. S. "Each mil of $\frac{N}{10}$ H_2SO_4 V. S., consumed corresponds to 28.92 mg. of the total alkaloids of Belladonna Root."

What was the alkaloid percentage strength of your sample?.....

What is the standard?.....

The principal alkaloid of Belladonna is atropine ($C_{17}H_{22}O_3N$). Belladonna is used to diminish secretion, relax spasm of involuntary muscle, stimulate a depressed nervous system, or produce dilatation of the pupil.

Official Preparations.

Extractum Belladonnæ Foliorum, 1.2% strength. Dose, 0.015 Gm.
Tinctura Belladonnæ Foliorum, 0.03% strength. Dose, 0.75 mil.
Unguentum Belladonnæ, made from the extract; 10% of the extract.
Fluidextractum Belladonnæ Radicis, 0.45% strength. Dose, 0.05 mil.
Linimentum Belladonnæ, 95% Fluidextract.
Atropina. Dose, 0.0005 Gm.
Atropinæ Sulphas. Dose, 0.0005 Gm.

BENZOINUM.

Benzoin is a balsamic resin obtained from *Styrax Benzoin* (Fam. *Styracaceæ*), trees of the Malay Peninsula and Dutch East Indies.

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	KOH .....

ATROPA BELLADONNA.

Heat a few fragments in a test-tube, and note the character of the sublimate .....

The compound tincture is frequently used as an inhalant in steam for the treatment of acute laryngitis.

The official preparations containing Benzoin are: Adeps Benzoinatus, Tinctura Benzoini, Tinctura Benzoini Composita.

BENZOSULPHINIDUM.

Saccharin is "the anhydride of ortho-sulphamide-benzoic acid"; it is a laboratory product of toluene.

Properties:

Appearance .....
Color .....
Odor .....
Taste, 1 to 10,000 sol. .....

Solubility:
Cold H_2O .....
Hot H_2O .....
C_2H_5OH .....
NH_4OH .....

Add 0.06 Gm. citric acid to a 1 to 10,000 solution Saccharin, and compare relative sweetness with that first tasted.....

Incinerate 0.008 Gm. Saccharin. What odor evolved?.....

Benzosulphinide is used as a substitute for sugar in cases of diabetes, but frequently is not tolerated very long.

The official Sodii Benzosulphinidum is more soluble.

BISMUTHI SUBCARBONAS.

Bismuth Subcarbonate is obtained by the interaction of ammonium carbonate and purified bismuth nitrate. It is rather variable in chemical composition.

Properties:

Appearance .....
Feel .....
Color .....
Odor .....

Taste .....
Solubility:
H_2O .....
C_2H_5OH .....

Incompatibilities: Add some Bismuth Subcarbonate to

HCl, T. S. .....
KOH, T. S. .....

KI, T. S. .....
Ac. Tan., T. S. .....

Bismuth Subcarbonate is used chiefly for its protective coating effect in inflammations of the intestinal mucosa. Dose, 0.5 Gm.

The other official bismuth preparations are: Bismuthi et Ammonii Citras, Bismuthi Betanaphtholas, Bismuthi Subgallas, Bismuthi Subnitras, Bismuthi Subsalicylas —all of which are either superfluous or of questionable utility.

CAFFEINA.

Caffeine is a xanthine compound derived from the dried seeds of *Coffea arabica* (Fam. *Rubiaceæ*), a native of Arabia. It is also obtained from the leaves of *Thea sinensis* (Fam. *Ternstræmiaceæ*), an Asiatic shrub. It also occurs in other plants, and may be prepared synthetically.

By treating Caffeine with citric acid in hot water there results a substance of loose chemical structure known as Citrated Caffeine.

Properties:

Caffeine:	Citrated Caffeine:
Appearance	Appearance
Color	Color
Odor	Odor
Taste	Taste
Solubility:	Solubility:
4 H_2O	4 H_2O
8 H_2O	8 H_2O
25 H_2O	25 H_2O
50 H_2O	50 H_2O
Hot H_2O	Hot H_2O
C_2H_5OH	C_2H_5OH

Caffeine is a stimulant to respiration, kidney activity, and cerebrospinal reflexes. It also seems to improve vascular conditions when the circulatory system is functionally enfeebled. Dose of Caffeina, 0.15 Gm.; of Caffeina Citrata, 0.3 Gm.

Other Official Preparations.

Caffeina Citrata Effervescens. Dose, 4 Gm.

Caffeinæ Sodio-Benzoas. Dose, by mouth, 0.3 Gm.; hypodermic, 0.2 Gm.

This latter substance is a mixture of about 46% anhydrous caffeine and about 54% sodium benzoate.

Two other xanthin products are the official Theophyllina, found in small amounts in tea leaves, and also made synthetically; and Theobromine, derived from *Theobroma Cacao*, with an official salt, Theobrominæ Sodio-Salicylas. These two substances are both dimethylxanthine. They possess but little advantage over the trimethylxanthine Caffeine, though a more marked diuretic action, with no cerebral effect, is claimed for theobromine.

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STRAMONIUM PLANTS IN FRUIT (*Datura stramonium*).

CALCIUM.

A number of lime salts are official, though none of them has any extended utility.

Properties:

Preparation	Appear.	Color	Odor	Taste	Sol. H_2O	Dose
Calcii Bromidum					1 to 0.7	1 Gm.
C. Carbonas Præcipitat.					Insol.	1 Gm.
C. Chloridum					1 to 0.62	0.5 Gm.
C. Glycerophosphas					1 to 50	0.25 Gm.
C. Hypophosphis					1 to 6.5	0.5 Gm.
C. Lactas					1 to 20	0.5 Gm.
C. Sulphidum Crudum					Slight.	0.06 Gm.
Calx = C. Oxidum					1 to 840	.....
Calx Chlorinata					Partly	.....
Creta Præparata					Insol.	1 Gm.

Calcium Bromide owes its chief activity to the bromine elements. The Precipitated Carbonate, like the other official carbonate, Prepared Chalk, was formerly of considerable repute in the treatment of infantile diarrheas, but is now used chiefly in dentifrices. Calcium Chloride is too harsh for internal use, even if any known indication existed. The Glycerophosphate and Hypophosphite are practically inert, and should be discarded. The Lactate is the preferable salt, if a definite indication for lime arises. The Sulphide is a crude cosmetic preparation. Chlorinated Lime is a popular and moderately efficient deodorant disinfectant. The Oxide, in the form of liquor calcis, is frequently recommended as an antacid to be added to cow's milk in infant feeding, though cow's milk normally has more lime than human milk, in which case probably sodium bicarbonate would be a preferable antacid.

CAMPHORA.

Camphor ($C_{10}H_{16}O$) is a purified sublimate obtained by distilling the wood of *Cinnamomum Camphora* (Fam. *Lauraceæ*), trees native to Eastern Asia.

Properties:

Appearance .....

Color .....

Odor .....

Taste .....

Solubility:

H_2O .....

C_2H_5OH .....

$CHCl_3$ .....

Oils .....

Incompatibilities:

What results from triturating 1 Gm. Camphor with an equal amount of chloral, menthol, or salol?.....

Camphor is principally useful as a mild counterirritant. Its use internally does not seem justified by any of its known reactions.

The official Camphora Monobromata is superfluous.

CANNABIS.

The Cannabis, or Indian Hemp of commerce, consists of the dried flowering tops of the pistillate plants of *Cannabis sativa* and *C. indica* (Fam. *Moraceæ*). It contains a resin, *Cannabin*.

Properties of powdered Cannabis:

Appearance	Odor .....
Color	Taste .....

Examine microscopically for pollen grains.....

Miscibility with H_2O (use the tincture).....

Cannabis may be used as a cerebral sedative and hypnotic whenever the use of opium for that purpose seems inadvisable. It is efficient in only about 50% of all cases.

Official preparations are: the Extract, the Fluidextract, and the Tincture.

CASCARA SAGRADA.

Cascara consists of the dried bark of *Rhamnus Purshiana* (Fam. *Rhamnaceæ*), a small tree of Northern California.

Properties of the powdered bark:

Appearance	Odor .....
Color	Taste .....

Cascara is used as a mild laxative to correct habitual constipation. Dose, 1 Gm.

The official preparations are: the Extract, the Fluidextract and the Aromatic Fluidextract.

CHLORALUM HYDRATUM.

Chloral is the hydrated product of trichloraldehyde ($CCl_3COH + H_2O$).

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	Olive oil .....

Incompatibilities: To Chloral Hydrate, T. S., add

NH_4OH, T. S.	KI, T. S. .....
NaOH, T. S.	Quin. Sulph., T. S. .....

Triturate some Chloral Hydrate with camphor.....

Chloral Hydrate is used principally as a hypnotic. Dose, 0.5 Gm.

Two other hypnotics of the methane group are Sulphonethylmethane (trional), and Sulphonmethane (sulphonal).

Properties:

Sulphonethylmethane:

Appearance .....

Color .....

Odor .....

Taste .....

Solubility:

H_2O, *A*= .....

B= .....

C_2H_5OH, *A*= .....

B= .....

Sulphonmethane:

Appearance .....

Color .....

Odor .....

Taste .....

Solubility:

H_2O, *A*= .....

B= .....

C_2H_5OH, *A*= .....

B= .....

Triturate each of these substances with Chloral.....

Both of these drugs are used as quietants and hypnotics, but are less certain in action than Chloral, and somewhat more dangerous. Dose (of either), 0.75 Gm.

CHLOROFORMUM.

Chloroform, or Trichlormethane ($CHCl_3$), is prepared on a commercial scale by treating a pure acetone with chlorinated lime. Usually, less than 1% of alcohol is added to prevent decomposition. Chloroform should be kept in well-stoppered bottles, in a cool place, and well protected from light. It should never be used near an open flame, lest irritating decomposition vapors be developed.

Properties:

Appearance .....

Color .....

Odor .....

Taste .....

Volatility .....

Miscibility:

H_2O .....

C_2H_5OH .....

Ether .....

Oils .....

Evaporate some Chloroform from filter paper laid on a warm glass plate. When Chloroform is completely evaporated, note if filter paper has any foreign odor.....

The principal use for Chloroform is for the production of general anæsthesia.

Official preparations are: Aqua Chloroformi, Linimentum Chloroformi, Spiritus Chloroformi.

CINCHONA.

Cinchona is the dried bark of several species of *Cinchona* (Fam. *Rubiaceæ*). Yellow Cinchona is chiefly from *C. Calisaya* and *C. Ledgeriana;* Red Cinchona is obtained from *C. succirubra*—all native trees of South America. In the bark of Cinchona are found over 25 different alkaloids, the most important of which is Quinine, though the sulphate salts of both Cinchonidine and Cinchonine are official. There are nine official salts of Quinine; the Hydrochloride and the Tannate amply meet all indications for quinine action. The Sulphate has had the widest use hitherto.

Properties:

	Q. Hydrochloride = 81.7% Quinine	Q. Sulphate = 74.3% Quinine	Q. Tannate = 35% Quinine
Appearance			
Color			
Odor			
Taste			
Sol. H_2O			
Reaction			
Sol. H_2O + acid			
Sol. C_2H_5OH			
Incompat. Test			
Na_2CO_3 T. S.			
$Na_2B_4O_7$ T. S.			
$Pb(C_2H_3O_2)_2$ T. S.			
$HgI_2(KI)_2$			
Specific Test	2gtt. Bromine + 1 mil NH_4OH =	+ $BaCl_2$ = + HCl =	+ $FeCl_3$ T. S. =
Dose (anti-malar.)	1 Gm.	1 Gm.	0.2 Gm.

Quinine is specific for malaria, in a great percentage of all cases. It has very little therapeutic efficiency otherwise.

The other official alkaloids and salts are: Quinina, Q. Bisulphas, Q. Dihydrochloridum, Q. Salicylas, Q. Hydrobromidum, and Q. et Ureæ Hydrochloridum.

From Yellow Cinchona are made a Fluidextract and a Tincture; from Red Cinchona, a Compound Tincture (Huxham's).

COCAINA.

Cocaine is an alkaloid obtained from the leaves of *Erythroxylon Coca* and other species of the family *Erythroxylaceæ,* tall shrubs native to equatorial South America. The hydrochloride salt of the alkaloid is the substance used in medicine.

Properties:

Appearance .....
Color .....
Odor .....
Taste .....

Solubility:
H_2O .....
C_2H_5OH .....

Incompatibilities: To a 0.5% sol. Cocaine Hydrochloride add

$AgNO_3$, T. S. ..... Na_2CO_3, T. S. .....

Cocaine Hydrochloride is decomposed by boiling water.

The chief use for Cocaine is to produce regional anæsthesia.

Cocaine is not without danger, and several substitutes have been offered. Of these the least toxic and least irritating is Procaine, but it is also least powerful.

COLOCYNTHIS.

Colocynth is the pulp of the dried fruit of *Citrullus Colocynthis* (Fam. *Cucurbitaceæ*), a native of Southwestern Asia and Northern Africa.

Properties:

Appearance .....
Color .....

Odor .....
Taste .....

Colocynth is used in various pills for its strong purgative properties.

An official preparation is the Extract, from which is made the Compound Extract, which is one ingredient of Pilulæ Catharticæ Compositæ.

CRESOL.

The official Cresol is a purified mixture of those isomeric cresols distilled from coal-tar at temperatures varying between 190° C. and 205° C.

Properties:

Appearance ..... Color ..... Odor .....

Appearance when mixed with water.....

Cresol is an antiseptic of value, but is more readily used in the form of the official Liquor Cresolis Compositus. Prepare this compound as follows:

In a tared vessel heat 30 Gm. linseed oil over a water bath to a temperature of 70° C. In the meanwhile dissolve 8 Gm. KOH (or 5.4 Gm. NaOH) in 5 mils H_2O, warm to 70° C., add to the linseed oil, and mix thoroughly; then add 3 mils alcohol, continuing to heat the mixture, without stirring, until emulsification is complete. Then add 50 Gm. Cresol, mix thoroughly, maintaining temperature at 70° C., until a

clear solution is produced. Finally, add enough water to make the finished product weigh 100 Gm.

Properties of Liquor Cresolis Compositus:

Appearance	Solubility:
Color	H_2O .....
Odor	Appearance of solution .....
Taste	

Liquor Cresolis Compositus is used as an antiseptic wash in the strength of a 5% solution in sterile water.

DIGITALIS.

Digitalis, or Foxglove (originally *Folk's glove*), consists of the carefully dried leaves of *Digitalis purpurea* (Fam. *Scrophulariaceæ*).

Properties:

D. Leaf:	D. Powder:
Appearance	Appearance .....
Color	Color .....
Odor	Odor .....
Taste	Taste .....
Tinct. Digitalis:	Digitoxin:
Appearance	Appearance .....
Color	Color .....
Odor	Odor .....
Taste	Taste .....

No alkaloid has as yet been isolated from Digitalis, though some uncertain glucosides, *digitonin, digitalin,* and *digitalein,* and a crystallizable principle, *digitoxin,* have been discovered, and extensively studied. Digitonin, constituting more than half the mixed glucosides, is soluble in water and alcohol. Digitoxin is soluble in alcohol, but not in water, if pure. Digitalin is slightly soluble in either; and digitalein readily soluble.

No satisfactory assay is available for Digitalis, though manufacturers make an approximate assay by means of the biological test. In this test about 0.006 mil Tincture Digitalis per gram weight of frog is given as the standard amount required to produce the frog's death by cardiac arrest in just one hour. In reference to this, it should be said that the real value of the test is materially affected by many factors pertaining to the condition, age, sex, species, habitat, etc., of the frog.

Digitalis has its principal utility in medicine in the treatment of auricular fibrillation, and in uncompensated valvular insufficiency. Dose, 0.06 Gm., repeated cautiously.

Official preparations are: the Fluidextract, the Infusion, and the Tincture, the last being the best preparation to use.

DIGITALIS PURPUREA.

ERGOTA.

Ergot is the carefully dried hyphæ of *Claviceps purpurea;* a fungus growing on the unripe fruit of rye, wheat, and corn, that growing on rye constituting the official ergot. This should be kept in opaque, tightly closed containers.

Properties:

Appearance ..... | Odor .....

Color ..... | Taste .....

Incompatibilities:

Tannic acid ..... Caustic alkali ..... Metallic salt .....

The principal use of Ergot is to induce contractions of the uterus, thereby tending to prevent *post-partum* hemorrhage. Dose, 2 Gm., better given however, in the form of the Fluidextract.

The Extract and Fluidextract are official.

FERRUM.

The more important Iron preparations are:

Ferri Carbonas Saccharatus = 15% $FeCO_3$. Average dose, 0.25 Gm.

Ferri Chloridum = 20% Fe. Average dose, 0.06 Gm.

Ferri et Quininæ Citras, = 13% Fe, and 11.5% Quinine. Average dose, 0.25 Gm.

Ferri Phosphas = 12% Fe. Average dose, 0.25 Gm.

Ferri Sulphas Granulatus, about 55% $FeSO_4$. Average dose, 0.1 Gm. Used also in preparing Pilulæ Ferri Carbonatis.

Properties:

	Ferri Carbonas Saccharatus	Ferri Chloridum	Ferri et Quininæ Citras	Ferri Phosphas	Ferri Sulphas Granulatus
Appearance					
Color					
Odor					
Taste					
Sol. H_2O					
Reaction					
Sol. $H_2O + HCl$					
Sol. C_2H_5OH					
Sol. $C_3H_5(OH)_3$					
Effect of air					

Properties (continued):

	Ferri Carbonas Saccharatus	Ferri Chloridum	Ferri et Quininæ Citras	Ferri Phosphas	Ferri Sulphas Granulatus
Incompat.:					
NH_4OH					
Na_2CO_3					
KOH					
$K_4Fe(CN)_6$					
Albumin					
$HgCl_2$					
$AgNO_3$					
KI					
Ac. Tannic.					
Veg. Infus.					

Iron is used principally in those cases of anæmia and chlorosis in which a deficiency of hæmic iron exists.

GENTIANA.

Gentian consists of the dried rhizome and roots of *Gentiana lutea,* (Fam. *Gentianaceæ*), a perennial herb of Central Europe.

Properties of powdered Gentian:

Appearance ..... | Odor .....

Color ..... | Taste .....

Incompatibilities: To Fluidextractum Gentianæ add

Sol. Sb. et K. Tartras ..... Plumbi Subacetas ..... Ferri Chloridum .....

Gentian is used as a bitters for promoting appetite and hunger.

The official preparations are: the Extract, the Fluidextract and the Compound Tincture.

GLYCERINUM.

Glycerin, or Glycerol, is a trihydric alcohol obtained by hydrolysis of vegetable or animal fats, or fixed oils, and purified by distillation.

Properties:

Appearance ..... | Effect of exposure to air .....

Color ..... | Miscibility and reaction:

Odor ..... | H_2O .....

Taste ..... | C_2H_5OH .....

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DIGITALIS IN FLOWER (*Digitalis purpurea*).

Incompatibilities: To some Glycerin add

$AgNO_3$, T. S. ..... K_2MnO_4, T. S. .....

Glycerin forms an explosive compound with con. HNO_3, or when triturated with any dry, quickly-oxidizing substances.

Aside from its great utility as a solvent, Glycerin is used chiefly for its emollient and extractive properties.

Official preparations are: Glycerinated Gelatin, Glycerin Suppositories, and Glycerites of Tannic Acid, Starch, Boroglycerin, Hydrastis, and Phenol.

GLYCYRRHIZA.

Licorice consists of the dried rhizome and roots of *Glycyrrhiza glabra,* (Fam. *Leguminosæ*), coming from both Spain and Russia. The Spanish variety is somewhat the darker.

Properties of powdered Licorice:

Appearance ..... | Odor .....

Color ..... | Taste .....

Boil 5 Gm. Licorice Powder in 30 mils H_2O for 5 minutes; filter and note:

Color ..... Odor ..... Taste .....

Although Licorice is a mild laxative, it is used principally for disguising the taste of bitter or salty medicines.

Official preparations are: the pure Extract, Fluidextract, Elixir, Compound Mixture, Compound Powder, and Ammoniated Licorice.

HEXAMETHYLENAMINA.

Hexamethylenamine is a product obtained by treating 40% formaldehyde solution with stronger ammonia water. It should be kept in tight containers.

Properties:

Appearance ..... | Solubility and reaction:

Color ..... | H_2O .....

Odor ..... | C_2H_5OH .....

Taste ..... |

Incompatibilities: To Hexamethylenamina, 10% sol., add

Ac. Tann., T. S. ..... $HgCl_2$ ..... H_2SO_4, dil. .....

Hexamethylenamine is used principally as a urinary disinfectant, some free formaldehyde being formed in acid urine. Dose, 0.25 Gm., diluted with at least 250 mils H_2O.

HYDRARGYRUM.

Mercury is obtained by roasting the native sulphide.

	Hydrargyrum	Hydrarg. Chloridum Corrosiv.	Hydrarg. Chloridum Mite	Hydrarg. Iodidum Flavum	Hydrarg. Oxidum Flavum	Hydrarg. Ammoniatum
Appearance						
Color						
Odor						
Taste	Do not	Do not				
Exposure	Sl. volatile	Perm.	Perm.	Decomp.	Darkens	Perm.
Sol. H_2O						
Sol. C_2H_5OH						
Incompat.						
Albumin						
Na_2CO_3						
Quin. S.						
$Na_2B_4O_7$						
$CuSO_4$						
$FeCl_3$						
KI						
PbSubac.						
Liq. Calc.						
$AgNO_3$						
K_2SO_4						
Ac. Tann.						
$ZnSO_4$						
Uses and Dosage	Base	Antiseptic 1 to 1000 Alterative 0.003 Gm.	Laxative 0.01 Gm. Purge 0.06 Gm.	Syphilis 0.01 Gm.	Locally as antiseptic	Locally in skin troubles
Preparations	Hg. c. Creta Massa Hg. Ung. Hg. Ung. Hg. dil.	Toxitab. Hg. Chl. Corros.	Pilulæ Cathart. Comp.		Ung. Hg. Oxidi Flavi	Ung. Hg. Ammon.

Q. 10, 13.
after Sowerby

HYOSCYAMUS NIGER.

Other less important preparations of Mercury are: the Red Iodide, the Red Oxide, and the Salicylate.

HYDRASTIS.

Hydrastis, or Golden Seal, consists of the dried rhizome and roots of *Hydrastis canadensis* (Fam. *Ranunculaceæ*), perennial herb, native to Northern United States and Canada. It owes its activity to an alkaloid, hydrastine ($C_{21}H_{21}O_6N$).

Properties:

Hydrastis:	Hydrastin HCl:
Appearance	Appearance
Color	Color
Odor	Odor
Taste	Taste

Incompatibilities: To Tincture Hydrastis add

An alkali	A borate
Ac. Tannic.	An iodide
A carbonate	

Hydrastis acts as a mild stimulant irritant to mucous membrane. Average dose, 2 Gm.; Hydrastinæ Hydrochloridum, 0.01 Gm.

Other official preparations are: Hydrastine, Hydrastinine Hydrochloride, the Extract, Fluidextract, Glycerite, and Tincture.

HYOSCYAMUS.

Hyoscyamus, or Henbane, consists of the dried leaves and flowering tops of *Hyoscyamus niger* (Fam. *Solanaceæ*), a biennial herb native to Eurasia, but cultivated in England and North America.

Properties:

	Appearance	Color	Odor	Taste
Hyoscyamus				
Hyoscyaminæ Hydrobromidum				Do not
Scopolaminæ Hydrobromidum				Do not

Hyoscyamus possesses two alkaloids fairly common to the *Solanaceæ*—Hyoscyamine and Hyoscine (or Scopolamine). To these alkaloids the drug owes its chief activity. Hyoscyamine is a peripheral paralyzant similar to atropine, while Scopolamine is a cerebral sedative. Dose of Hyoscyamus, 0.25 Gm.; of Hyoscyamine Hydrobromide, 0.0003 Gm.; of Scopolamine, 0.0003 Gm.

Official preparations of Hyoscyamus are: the Extract, Fluidextract, and Tincture.

IODUM.

Iodine is a non-metallic element, formerly derived largely from kelp, but now obtained chiefly from Chilean saltpetre. It should be kept in glass-stoppered bottles in a cool place.

Properties:

Appearance	Solubility:	
Color	H_2O	Discoloration of skin .....
Odor	$H_2O + KI$	Apply NH_4OH .....
Taste	C_2H_5OH	

What is the characteristic test for Iodine?.....

Iodine, in the form of the tincture, is used in medicine as a counterirritant, and in surgery as a surface disinfectant.

Official preparations made from Iodine are: the Compound Liquor, the Tincture, and the Unguent.

Derived from Iodine are potassium iodide, used extensively as an alterative in syphilis; thymol iodide, used for a surgical dressing; iodoform, which should be discarded; and the iodides of ammonium, sodium, strontium—all superfluous preparations.

Properties:

Iodoform:	Potass. Iod.:	Thymol Iod.:
Appearance	Appearance	Appearance .....
Color	Color	Color .....
Odor	Odor	Odor .....
Taste	Taste	Taste .....

IPECACUANHA.

Ipecac consists of the dried root of *Cephaëlis Ipecacuanha,* and *C. acuminata* (Fam. *Rubiaceæ*), small plants native to Colombia and Brazil. The drug owes its activity to two alkaloids—emetine, whose chloride salt is official, and cephaëline.

Properties:

Ipecac:	Emet. Hydrochl.:
Appearance	Appearance .....
Color	Color .....
Odor	Odor .....
Taste	Taste .....
Sol.: H_2O	Sol.: H_2O .....

Acids, lead and mercury salts, and vegetable infusions of an astringent character, are incompatible.

Ipecac, long a favorite nauseating emetic in acute bronchitis, is now more extensively employed as a specific in amœbic dysentery. For this the alkaloid, emetine hy-

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BIENNIAL HENBANE IN SEED (*Hyoscyamus niger*).

drochloride, is advised in 0.032 Gm. repeated doses by hypodermic. This alkaloid is also being widely studied for its effects on pyorrhœa.

Official preparations are: the Fluidextract, the Powder of Ipecac and Opium (Dover's), and the Syrup.

JALAPA.

Jalap consists of the dried tuberous root of *Exogonium Purga* (Fam. *Convolvulaceæ*), a perennial herb, native to Eastern Mexico. It yields not less than 7% of resinous principles.

Properties of Jalap powder:

Appearance	Odor .....
Color	Taste .....

Jalap is a powerful hydrogogue purgative. Dose, 1 Gm.

Official preparations are: Compound Cathartic Pill, Compound Powder, and the Resin.

MAGNESII SULPHAS.

The Sulphate of Magnesia, or Epsom Salt, contains approximately 50% anhydrous magnesium sulphate. It should be kept in tight containers.

Properties:

Appearance	Effect when exposed to air .....
Color	Solubility in H_2O .....
Odor	C_2H_5OH .....
Taste	

Magnesium Sulphate is a drastic hydrogogue purgative. Dose, 15 Gm. Epsom Salt is also one ingredient in Infusum Sennæ Compositum.

Other official preparations of Magnesia are the Carbonate, and the Light and Heavy Oxides, each of which is somewhat dubiously used as an antacid.

METHYLIS SALICYLAS.

Methyl Salicylate is obtained by distillation from *Gaultheria procumbens* (Fam. *Ericaceæ*). A chemically-identical substance is similarly obtained from *Betula lenta* (Fam. *Betulaceæ*); or it may be made synthetically by treating salicylic acid with methyl alcohol and sulphuric acid, and distilling the product.

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	70% C_2H_5OH .....
Taste	

Methyl Salicylate has much the same action as other salicylates, being thus used for the treatment of acute rheumatism. Dose, 0.75 mil.

NUX VOMICA.

Nux Vomica consists of the dried ripe seeds of *Strychnos Nux-vomica* (Fam. *Loganiaceæ*), a small tree indigenous to Indo-Asia. It owes its activity principally to the alkaloid strychnine, of which it contains about 2.5%.

Properties:

Nux Vomica:	Strych. Sulph.:
Appearance	Appearance .....
Color	Color .....
Odor	Odor .....
Taste	Taste .....
Sol.: H_2O	Sol.: H_2O .....

Incompatibilities: To Tincture Nux Vomica add

An hydroxide	An iodide .....
A carbonate	Ac. Tannic .....
A bromide	

Test for Strychnine: In 1 mil H_2SO_4 place 0.05 Gm. Strychnine; then drop in a small fragment of K_2CrO_7; five sequent color changes should be noted: .....

.....

Nux Vomica is used as a bitters. Dose, 0.06 Gm. Strychnine is used to heighten the excitability of the spinal reflexes. Dose, of Strychnine or of the Nitrate or Sulphate, 0.0015 Gm.

Official preparations are: the Extract, the Fluidextract, and the Tincture.

OLEA.

"Oils are liquid or solid substances, unctuous to the touch, and characterized by inflammability and the property of leaving a greasy stain upon paper." They may be arranged in two classes, Fixed and Volatile, depending on their behavior on the application of heat.

The more important Fixed Oils are:

Oleum Olivæ, Olive Oil, obtained from the ripe fruit of *Olea europea* (Fam. *Oleaceæ*), native of Eurasia. It is used as a nutritive in adults, and as a mild laxative (dose, 5 to 20 mils) in infants.

Oleum Ricini, Castor Oil, derived from the seeds of *Ricinus communis,* (Fam. *Euphorbiaceæ*), native of India. It is used as a purgative in fermentative diarrheas, cholera morbus, and acute constipation. Dose, 15 mils.

Oleum Tiglii, Croton Oil, obtained from the seeds of *Croton tiglii* (Fam. *Euphorbiaceæ*), native of India and the Philippines. It is used with great caution as a prompt, powerful, drastic purge for a depletant in cerebral congestions, and to assist in overcoming acute obstipation. Dose, 0.05 mil in olive oil.

Less important official Fixed Oils are:

Oleum Amygdalæ Expressum, Oleum Sesami, Oleum Theobromatis (all used as emollients); Oleum Gossypii Seminis, (a demulcent and common substitute for olive oil); Oleum Lini (used to prepare "Carron Oil"); and Oleum Morrhuæ (a discarded treatment for tuberculosis).

Adeps, Adeps Lanæ, Cera Flava, or beeswax, and Cetaceum, or spermaceti, are other forms of official fixed oils.

The Volatile Oils are all liquid preparations, usually obtained by distilling the flowers, seeds, fruits, leaves, or bark of odoriferous plants. These oils may best be classified according to the predominating chemical constituent.

Group I.—Oils in which terpenes predominate:

Oleum Aurantii, Oil of Sweet Orange, expressed from the fresh peel of *Citrus Aurantium sinensis* (Fam. *Rutaceæ*). Used as a flavoring agent in preparing Spiritus Aurantii Compositus.

Oleum Terebinthinæ Rectificatum, Rectified "Spirits of Turpentine," a purified distillate from the oleoresin of *Pinus palustris* and other species of *Pinaceæ*. Used externally as a rubefacient, and internally as a carminative in doses of 0.3 mil.

Group II.—Oils in which alcohols and their esters predominate:

Oleum Coriandri, Oil of Coriander, distilled from the ripe fruit of *Coriandrum sativum* (Fam. *Umbelliferæ*) native of Italy. A mild carminative; also a flavoring agent used in *Syrupus Sennæ*.

Oleum Lavandulæ, Oil of Lavender, distilled from the fresh flowers of *Lavandula vera* (Fam. *Labiatæ*), native of South Europe. A carminative; also a flavor for Tinctura Lavandulæ Composita.

Group III.—Oils in which aldehydes predominate:

Oleum Cassiæ, Oil of Cinnamon, a rectified oil distilled from *Cinnamomum Cassia* (Fam. *Lauraceæ*), growing in Ceylon. Used as a carminative; also a flavor in Aqua Cinnamomi and Spiritus Cinnamomi.

Oleum Limonis, Oil of Lemon, expressed from the fresh peel of ripe *Citrus medica Limonum* (Fam. *Rutaceæ*). Used for flavoring.

Group IV.—Oils in which a ketone predominates:

Oleum Menthæ Piperitæ, Oil of Peppermint, distilled from the dried leaves and flowering tops of *Mentha piperita* (Fam. *Labiatæ*), a perennial plant of Eurasia and North America. Used as a carminative; also as a flavor in Aqua Menthæ Piperitæ, and in Spiritus Menthæ Piperitæ.

Group V.—Oils in which aromatic acids and esters predominate:

Oleum Gaultheriæ, and Oleum Betulæ; see Methylis Salicylas, page 33.

Group VI.—Oils in which phenols or their esters predominate:

Oleum Anisi, Oil of Star Anise, distilled from the ripe fruit of *Pimpinella Anisum* (Fam. *Umbelliferæ*), a plant of Russia. Used as a flavoring agent in Tinctura Opii Camphorata.

Other less important official volatile oils are:

Oleum Amygdalæ Amaræ	Group III	Formerly used for its HCN content
" Cajuputi	" *VII	Formerly used as a carminative
" Cari	" I	A flavor in Spir. Juniperi Comp.
" Caryophylli	" VI	A flavor; used also in poultices
" Chenopodii	" *VII	A vermifuge for the round-worm
" Cubebæ	" I	A discarded urinary antiseptic
" Eucalypti	" *VII	A mild nasal antiseptic
" Fœniculi	" VI	A discarded carminative
" Menthæ Viridis	" IV	A substitute for peppermint oil
" Myristicæ	" I	Used in "spice" poultice
" Picis Liquidæ Rect.	" I	Formerly used in tuberculosis
" Pimentæ	" VI	A savor
" Pini Pumilionis	" II	Used empirically for bronchitis
" Rosmarini	" II	Will drive away flies
" Santali	" II	Formerly used in G.-U. treatment
" Sassafras	" VI	A flavor
" Sinapis Volatile	" *VIII	A vesicating counterirritant
" Terebinthinæ	" I	For making the rectified "spirits"
" Thymi	" *VII	A flavoring agent

* See U. S. Dispensatory.

Properties of the Oils:

	Color	Odor	Taste	Sol. C_2H_5OH	Dose
Oleum Olivæ				Slight	30 mils
Oleum Ricini				Misc.	15 mils
Oleum Tiglii			Do not	Slight	0.05 mils
Oleum Gossypii Sem.				Slight	30 mils
Oleum Morrhuæ				Slight	10 mils
Oleum Aurantii				1 in 7	0.2 mil
Oleum Anisi				1 in 3	0.2 mil
Oleum Cassiæ				1 in 3	0.2 mil
Oleum Coriandri				1 in 3	0.2 mil
Oleum Lavandulæ				1 in 3	0.2 mil
Oleum Limonis					0.2 mil
Oleum Menthæ Piper.				1 in 4	0.2 mil
Oleum Terebin. Rect.				1 in 5	0.3 mil

PAPAVER SOMNIFERUM.

OPIUM.

Opium is the concrete, air-dried, milky juice that exudes from incisions made in the unripe seed capsules of *Papaver somniferum* (Fam. *Papaveraceæ*), an herbaceous Asiatic plant. When Opium is dried at a temperature not exceeding 70° C., and reduced to a fine powder (Opii Pulvis), it should yield not less than 10% of the principal alkaloid, morphine.

Properties:

	Pulvis Opii	Pulvis Opii et Ipecac.	Morphinæ Sulphas	Codeinæ Sulphas	Diacetyl-morphinæ Chloras	Apomorph. Chloras
Appearance						
Color						
Odor						
Taste					Do not	Do not
Solubility: H_2O	75%		1 in 15.5	1 in 30	1 in 2	1 in 50
C_2H_5OH	85%		1 in 565	1 in 1280		1 in 50
Incompat.: NH_4OH						
$CuSO_4$						
$NaHCO_3$						
$AgNO_3$						
Ac. Tan.						
Tests: $FeCl_3$	Use Tinct.	Use Tinct.				
HNO_3						
Pb. Acet.						
Ac. Phospho-molyb.						
Pharmacodynamics	Narcotic and analgesic	Narcotic and diaphoretic	Narcotic and analgesic	Cerebral depressant	Cerebral depressant	Stim. vom. centre
Use in medicine	Allay pain, Induce sleep	Abortant for "colds"	Hypnotic, Allay pain	Hypnotic, Allay cough	Induce amnesia, Danger!	Induce vomiting.
Dose.	0.06 Gm.	0.5 Gm.	0.008 Gm.	0.03 Gm.	0.003 Gm.	0.005 Gm.

The following official preparations are derived from Opium. From the crude drug:

Extractum Opii, at least 20% morphine. Dose, 0.03 Gm.

Pulvis Opii, at least 10% morphine. Dose, 0.06 Gm.

Opium Granulatum, at least 10% morphine. Dose, 0.06 Gm.

From the powdered drug are made:

Opium Deodoratum—abstraction of narcotine. Dose, 0.06 Gm.

Pulvis Ipecacuanhæ et Opii (10% of each). Dose, 0.5 Gm.

Tinctura Opii Camphorata (paregoric), 0.4% Opium. Dose, 4 mils. This is used in Mistura Glycyrrhizæ Composita.

From the granulated opium are made:

Tinctura Opii (laudanum), at least 10% morphine. Dose, 0.5 mil.

Tinctura Opii Deodorati, minus narcotine. Dose, 0.5 mil. This is a preferable preparation for simple analgesia.

The official alkaloids of Opium are:

Morphine, M. Hydrochloride, and M. Sulphate. Dose, āā, 0.008 Gm.

Codeine, C. Phosphate, and C. Sulphate. Dose, āā, 0.03 Gm.

Diacetylmorphine, and D. Hydrochloride. Dose, āā, 0.003 Gm.

Apomorphine Hydrochloride. Emetic dose, mouth, 0.01 Gm.; hypodermic, 0.005 Gm.

PARAFFINUM.

Paraffin is a purified mixture of solid hydrocarbons expressed from petroleum distillates of higher boiling points.

Properties:

Appearance	Odor .....
Touch	Taste .....
Color	

Insoluble in H_2O or C_2H_5OH. Soluble in ether, benzene, volatile oils.

Melting Point, 50° to 51° C. This is too high a melting point for practical utility in external medicine; 47° C. would be better.

Place a small amount of asphalt varnish in a test-tube; heat this in a water bath for half an hour. Place 0.75 Gm. olive oil in another test-tube, warm it on the water bath, add 2 drops of the hot varnish, mix thoroughly; then, with stirring, add this to 48.75 Gm. melted paraffin (melting point 47° C.). Apply some of this to your knuckles, allowing it to cool. At the same time apply on other knuckles some melted official paraffin. When both are well solidified, note comparative

Offic. Paraff.:	Prep. Paraff.:
Pliability	Pliability .....
Adhesiveness	Adhesiveness .....
Detachability	Detachability .....
Ductility	Ductility .....

Paraffin, prepared as above, is a useful surgical dressing.

PETROLATUM.

Petrolatum is a purified mixture of methane hydrocarbons. It is obtained from petroleum by distilling off the more volatile portions.

Petrolatum Album is petrolatum decolorized by filtering through animal charcoal. It is used extensively as a base for cerates and ointments.

Petrolatum Liquidum consists of those petroleum distillates boiling between 360° to 390° C., after the more volatile portions have been removed. It is further treated by being purified and decolorized. It has a wide use as a vehicle for medicaments intended to be used by atomization.

Properties:

Petrolatum:	Petr. Album :	Petr. Liquid.:
Appearance	Appearance	Appearance .....
Feel	Feel	Feel .....
Color	Color	Color .....
Odor	Odor	Odor .....
Taste	Taste	Taste .....

PHENOL.

Phenol is hydroxybenzene. It is customarily obtained from coal-tar by securing the oils boiling at 182° C., purifying, and redistilling. It is also made synthetically from benzene or from aniline. It should contain not less than 97% C_6H_5OH. Its solution in water is the official Phenol Liquefactum (= 87% C_6H_5OH).

Properties:

	Appearance	Color	Odor	Taste
Phenol				Do not taste
Phenol Liquefactum				1 to 100 dilut.

Gently heat some of the Phenol crystals.....

Incompatibilities: To Phenol T. S. add

Albumin, T. S.	K_2MnO_4, T. S. .....
Chloral Hyd.	Na_2HPO_4, T. S. .....
1 gt. $FeCl_3$	

Phenol is used as an antiseptic and disinfectant in 1% to 5% solutions. Locally it indurates and benumbs the skin. If used in too strong solutions, it will cauterize, and may produce gangrene. It has no well-defined internal utility.

PHENYLIS SALICYLAS.

Salol is the phenyl ester of salicylic acid.

Properties:

Appearance ..... | Odor .....

Color ..... | Taste .....

Note characteristic feel when bitten .....

Solubility: H_2O, 1 in 6670; C_2H_5OH, 1 in 6; very soluble in oils.

Incompatibilities:

To alcoholic solution (1 in 20) add dil. $FeCl_3$ .....

Triturate with camphor, or chloral .....

Phenyl Salicylate has been used in typhoid as an intestinal antiseptic; but perhaps more extensively in rheumatism as a substitute for other salicylates. Its use is not without danger, however, owing to the free phenol liberated in the intestines. Dose, 0.3 Gm.

PHYSOSTIGMA.

Physostigma, or Calabar Bean, consists of the dried ripe seeds of *Physostigma venenosum* (Fam. *Leguminoseæ*), a climbing woody plant of Western Africa. Its principal activity is due to the alkaloid physostigmine, the salicylate salt of which is official. This should be kept from the light.

Properties of P. Salicylate (Eserine Salicylate):

Appearance ..... | Odor .....

Color ..... | Do not taste.

Solubility: H_2O, 1 in 75; C_2H_5OH, 1 in 16.

To aq. sol. eserine add $FeCl_3$ T. S. .....

Physostigmine is used by clinicians to stimulate unstriped muscle fibres in the intestines in cases of acute obstipation. Dose, 0.001 Gm. It is also used by ophthalmologists to reduce intra-ocular tension.

PILOCARPUS.

Pilocarpus consists of the dried leaflets of *Pilocarpus Jaborandi,* and *P. microphyllus,* (Fam. *Rutaceæ*), woody shrubs native to Northeastern Brazil. From its principal alkaloid, pilocarpine, are prepared two official salts, the Hydrochloride and the Nitrate, the former being preferable because of its greater solubility.

Properties of P. Hydrochloride:

Appearance ..... | Odor .....

Color ..... | Taste .....

Solubility: H_2O, 1 in 0.3; C_2H_5OH, 1 in 3. Hygroscopic in air.

Characteristic test for Pilocarpine: Dissolve 0.005 Gm. Pilocarpine Hydrochloride in 2 mils distilled water, add 2 mils slightly acid solution H_2O_2; then add a thin

layer of benzene. Next add 3 drops 0.3% solution $K_2Cr_2O_7$. Shake mixture gently. The benzene layer becomes a ..... color, while the aqueous layer remains yellow.

Pilocarpine has been recommended as a powerful sudorific in grave emergencies like uræmias and renal dropsy. Dose, 0.005 Gm. hypodermically. On the eye it has a myotic effect similar to that of physostigmine.

PODOPHYLLUM.

Mandrake consists of the dried rhizome and roots of *Podophyllum peltatum* (Fam. *Berberidaceæ*), a perennial herb growing wild in shady thickets and woods in the United States and Canada. It should yield not less than 3% of resin.

From the powdered drug are made the Fluidextract, and the Resin (which is an aqueous precipitate from strong alcoholic extracts).

Properties:

Podophyllum:	Resin. Podoph.:
Appearance	Appearance .....
Color	Color .....
Odor	Odor .....
Taste	Taste .....

Resina Podophylli is a laxative and purgative of much value when used with discrimination. Dose, 0.005 to 0.01 Gm.

POTASSIUM AND SODIUM.

The salts of these two metals may be studied together, inasmuch as their respective actions are closely similar, the K ion being probably the more irritant of the two. Where the same salts of both metals are official, the sodium salt is usually to be preferred. Many of the official salts are either superfluous or are of commercial interest solely.

Properties:

	Appear.	Color	Odor	Taste	Sol. H_2O	Use	Dose
K. Bitart.					1 in 155	Laxative	2 Gm.
K. Chloras					1 in 11.5	Oral wash	Ext. only
KNa Tartr.					1 in 0.9	Laxative	10 Gm.
K. Iodid.					1 in 0.7	Syphilis	0.3 Gm.
K. Permang.					1 in 13.5	Antisept.	Ext. use

Properties (continued):

	Appear.	Color	Odor	Taste	Sol.: H_2O	Use	Dose
Na. Acetas					1 in 0.8	Diuretic	1 Gm.
Na. Benzoas					1 in 1.8	Rheumatism	1 Gm.
Na. Benzo-sulphinid.					1 in 1.2	Sweeten	0.2 Gm.
Na. Bicarb.					1 in 10	Antacid	1 Gm.
Na. Boras					1 in 15	Antiseptic	Ext.
Na. Bromid.					1 in 1.1	Depressant	1 Gm.
Na. Chlorid.					1 in 2.8	Osmosis	Solution
Na. Citras					1 in 1.3	Diuretic	1 Gm.
Na. Nitris					1 in 1.5	Anginas	0.06 Gm.
Na. Phosph.					1 in 2.7	Aperient	4 Gm.
Na. Salicyl.					1 in 0.9	Rheumatism	1 Gm.

Incompatibilities:

Aq. Solut.	HCl	$AgNO_3$	$FeCl_3$	KI	Pb. Subac.	Quin. Sul.	Special
K. Bitart.							Al. Carb.
K. Chloras				Poison			Org. matter
KNa Tartr.		Boil					$MgSO_4$
K. Iodid.			+Chlorof.				Use alone
K. Permang.							Use alone
Na. Acetas							
Na. Benzoas							
Na. Benzosulph.							
Na. Bicarb.							
Na. Boras							$HgCl_2$
Na. Bromid.							Sp. Ni. Eth.

Incompatibilities (continued):

Aq. Solut.	HCl	$AgNO_3$	$FeCl_3$	KI	Pb. Subac.	Quin. Sul.	Special
Na. Chlorid.							$HgCl_2$
Na. Citras							Chloral
Na. Nitris							Acetanilid
Na. Phosphas							$MgSO_4$
Na. Salicyl.							Sp. Ni. Eth.

The other official K. and Na. salts, not possessed of an essential therapeutic utility, or otherwise superfluous, are: K. Acetas, K. Bicarbonas, K. Bromidum, K. Carbonas, K. Citras, K. Citras Effervescens, K. Hydroxidum, K. Hypophosphis, K. Nitras. Na. Arsenas, Na. Arsenas Exsiccatus, Na. Cacodylas, Na. Carbonas Monohydratus, Na. Cyanidum, Na. Glycerophosphas, Na. Hypophosphis, Na. Indigotindisulphonas, Na. Perboras, Na. Phenolsulphonas, Na. Phosphas Exsiccatus, Na. Sulphas, Na. Sulphis Exsiccatus, Na. Thiosulphas.

RHEUM.

Rhubarb consists of the rhizomes and roots of *Rheum officinale* (Fam. *Polygonaceæ*) and other species of *Rheum*, coming from China and Thibet.

Properties of the powdered Rhubarb:

Appearance ..... | Odor .....

Color ..... | Taste .....

Color, when triturated with Na_2CO_3 .....

Feeling between the teeth when chewed .....

Use microscope to ascertain cause .....

Rhubarb is a useful laxative in the fermentative diarrheas of children. It has a mild, constipating after-effect.

The official preparations of Rhubarb are: the Extract, Fluidextract, Compound Pill, Compound Powder, Syrup, Aromatic Syrup, Tincture, and Aromatic Tincture. Of all these, the most desirable are the Aromatic Syrup (dose, 10 mils), and the Aromatic Tincture (dose, 2 mils).

SACCHARUM LACTIS.

Milk Sugar, or Lactose, is prepared from the whey of cow's milk. It should be kept in tight containers as it readily absorbs various odors.

Properties:

Appearance ..... | Feel on the tongue .....

Color ..... | Solubility:

Odor ..... | H_2O .....

Taste ..... | C_2H_5OH .....

Lactose is widely used as an added sugar in the modified-milk feeding of infants, and to furnish additional carbohydrate in those cases requiring an exclusive milk diet.

SENNA.

Senna consists of the dried leaflets of *Cassia acutifolia* (Fam. *Leguminosæ*), an African shrub, and *Cassia angustifolia,* a plant growing in India. It owes its medicinal action to the presence of an amorphous glucoside termed Cathartic acid.

Properties:

Appearance ..... | Odor .....

Color ..... | Taste .....

Senna is used as a laxative, and is of especial utility with infants and children. The griping tendency may be considerably minimized by the addition of coriander. Like rhubarb, Senna is eliminated in part by the mammary glands of a nursing mother, and will in such a case cause purgation of the suckling child.

SERUM ANTIDIPHTHERICUM PURIFICATUM.

This Serum represents a solution in normal saline of the diphtheria antitoxins derived from the blood plasma of a properly immunized horse.

Note its appearance ..... Color ..... Odor .....

This Serum is used as a preventative or curative of diphtheria. Each mil of the Serum contains not less than 250 antitoxic units, a "unit" being the amount of antitoxin necessary to protect a 250 Gm. guinea pig against 100 times the fatal dose of toxin.

Dose: Prophylactic, 1000 units; curative, 10,000 units, repeated as may be necessary.

SERUM ANTITETANICUM PURIFICATUM.

This Serum represents a solution in normal saline of the tetanus antitoxins derived from the blood plasma of a properly immunized horse. It has a potency of not less than 100 units per mil.

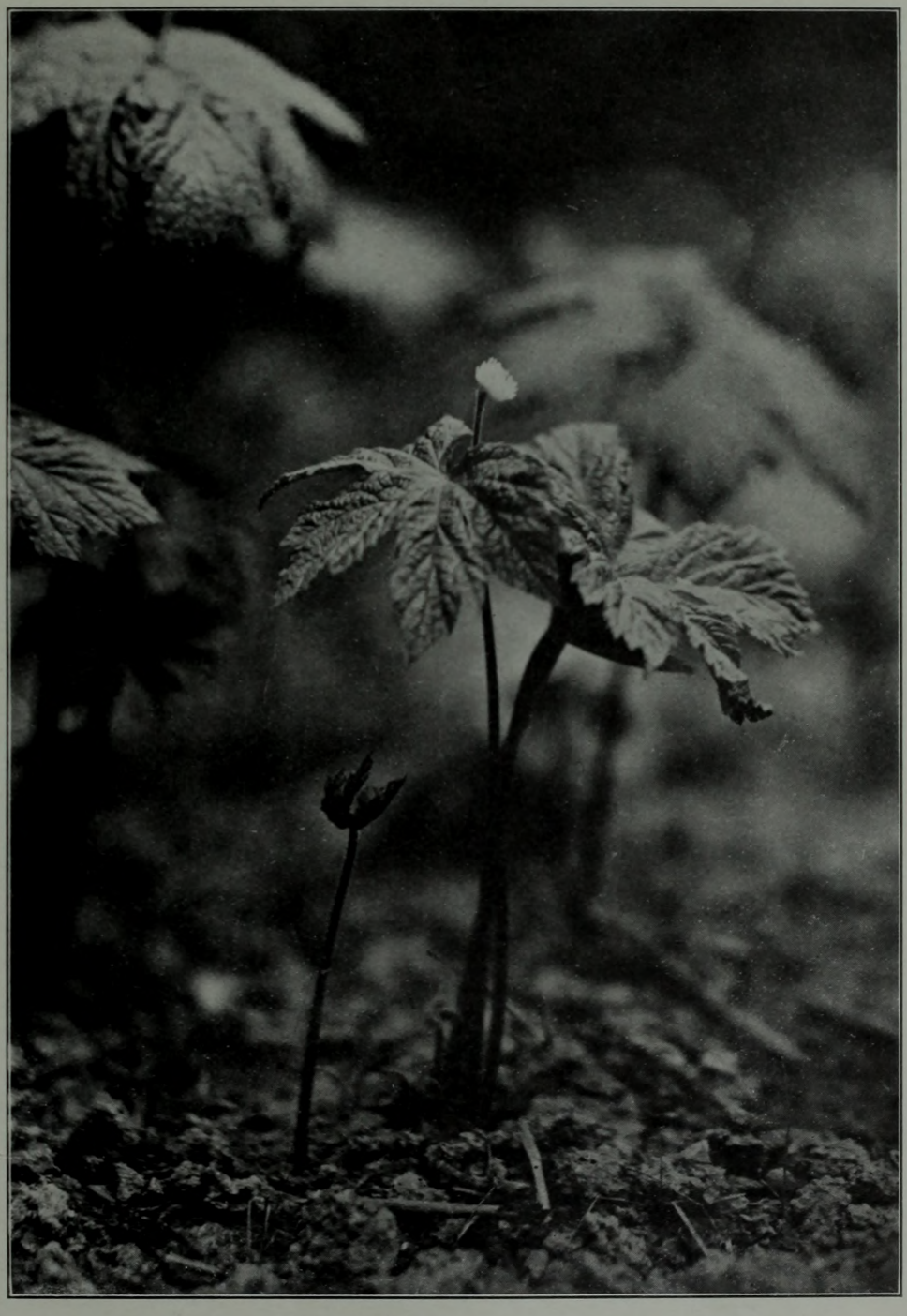
Note its appearance ..... Color ..... Odor .....

Antitetanic Serum is best used as a prophylactic for tetanus in doses of 1000 units. The possibility of a curative result is remote if the disease has become established. When treated early, a "curative" dose of 10,000 units may be essayed.

Each of the above Sera is official in three forms: the plain Serum, the Purified Serum, and the Dried Serum. The preferable preparation is the one selected for study.

SINAPIS.

Sinapis, or Mustard, consists of the dried ripe seeds of *Sinapis alba* and of *Brassica nigra* (both of the Fam. *Cruciferæ*), natives of Europe, but extensively cultivated elsewhere. These two Mustards manifest several variations in properties, the black variety being considerably the stronger.



HYDRASTIS PLANT IN BLOOM (*Hydrastis canadensis*).

Properties:

	Sinapis alba	Sinapis nigra
Appearance		
Color		
Odor when dry		
Odor when wet Use *tepid* water		
Taste		

Mustard is used for the irritating oil developed in the presence of moisture. It is a powerful, though not rapid, rubefacient and counterirritant, becoming a painful vesicant if applied too long a time. Usually an application for 20 minutes secures ample rubefaction. Mustard was formerly much used for emetic purposes, but is better supplanted by something less irritating to the gastric mucosa.

SULPHUR.

Sulphur is official in three forms: Sulphur Lotum, or Washed Sulphur; Sulphur Præcipitatum, or Milk of Sulphur; and Sulphur Sublimatum, or Flowers of Sulphur. The Washed Sulphur is best for internal use, the precipitated form for ointments, and the sublimed form for disinfection.

Properties:

	Sulphur Lotum	Sulphur Præcip.	Sulphur Sublim.
Appearance			
Color			
Odor			
Taste			
Feel			
Solubility: H_2O			
C_2H_5OH			
$CHCl_3$			
Olive Oil			
Reaction to litmus of water agitate			

Though much less than formerly, Sulphur is still used for its mild laxative effect, with soft stools. Dose, 4 Gm., Sulphur Lotum. Externally, it is a specific for scabies. When burned in the presence of adequate moisture it serves as a general fumigating disinfectant.

TERPINI HYDRAS.

Terpin Hydrate is obtained by crystallizing the hydrate of the diatomic alcohol, Terpin, out from a mixture of alcohol, nitric acid, and rectified oil of turpentine.

Properties:

Appearance	Odor .....
Color	Taste .....

Solubility: H_2O, 1 in 200; C_2H_5OH, 1 in 13. Effloresent in dry air.
Terpin is said to lessen cough in bronchitis. Dose, 0.25 Gm.

THYMOL.

Thymol is a phenol derived from the volatile oil of *Thymus vulgare* (Fam. *Labiatæ*). It should be kept in well-closed containers.

Properties:

Appearance	Solubility:
Color	H_2O .....
Odor	C_2H_5OH .....
Taste	Oils .....

Triturate a small amount with camphor .....

Triturate a small amount with acetanilid .....

To an alcoholic solution add KI, T. S. ..... $FeCl_3$, T. S. .....

Thymol internally is specific for uncinariasis duodenale. Dose, 1 Gm. a day, avoiding oils or fats in the meanwhile.

VERMIFUGE DRUGS.

Besides the thymol studied above, several other drugs are used for the expulsion of worms from the human body. These are:

Aspidium, which consists of the rhizomes and stipes of *Dryopteris Filix-mas,* or of *D. marginalis* (Fam. *Polypodiaceæ*). From the powdered drug is obtained the active Oleoresina Aspidii.

Santoninum, which is a neutral principle, the inner anhydride of santonic acid, is obtained from the unexpanded flower-heads of *Artemisia pauciflora,* or "Levant Wormseed" (Fam. *Compositæ*).

Quassia, which is the wood of *Picrasma excelsa,* or that of *Quassia amara* (both of the Fam. *Simarubaceæ*).

Properties:

	Oleores. Aspid.	Santoninum	Quassia
Appearance			
Color			
Odor			
Taste			
Solubility: H_2O			
C_2H_5OH			

Oleoresina Aspidii is an efficient anthelmintic for the treatment of tapeworm (*Tæniæ*). Single dose, 2 Gm., *once a day*.

Santonin is an efficient, though sometimes toxic, anthelmintic for the treatment of round-worm (*Ascaris lumbricoides*). Dose, 0.06 Gm.

Quassia, in the form of warm aqueous extracts injected into the rectum and sigmoid, is an efficient anthelmintic in the treatment of thread- or seat-worms (*Oxyuris vermicularis*).

VIRUS VACCINICUM.

Vaccine Virus consists of the specially prepared, glycerinated, lymphocytic exudates found in the dermal manifestations of vaccinia in young bovines. It is prepared in selected establishments, working under a Federal license, and under requirements and regulations prescribed by the U. S. Public Health Service.

Note: Appearance ..... Color ..... Odor .....

Vaccine Virus has an almost universal use in the production of vaccinia, or cowpox, a single attack of which mild disease almost always affords adequate immunity against variola.

ZINCUM.

Eight salts of Zinc are official, besides the metal. The Acetate is superfluous in medicine, while the Valerate is inert.

Properties:

	Zn. Carb. Præcip.	Zinci Chlorid.	Zinci Oxidum	Zn. Phenol-sulphonas	Zinci Stearas	Zinci Sulphas
Appearance						
Color						
Odor						
Taste		Do not				
Feel						

Properties (continued):

	Zn. Carb. Præcip.	Zinci Chlorid.	Zinci Oxidum	Zn. Phenol-sulphonas	Zinci Stearas	Zinci Sulphas
Sol. H_2O						
Reaction						
C_2H_5OH						
HCl, dil.						
NH_4OH						
Incompat. $(NH_4)_2CO_3$						
Liq. Calc.						
Ac. Tann.						
$AgNO_3$						
$FeCl_3$						
Utility	Ointment in wet eczemas	Powerful caustic	Protective in moist dermatitis	Antiseptic astringent wash	Protective dressing	Astringent wash; Emetic

ZINGIBER.

Ginger consists of the dried rhizomes of *Zingiber officinale* (Fam. *Zingiberaceæ*), an herb native to Hindustan, but cultivated in all subtropical countries. It owes its activity to an aromatic volatile oil and to a pungent resin.

Properties:

Appearance ..... | Odor .....

Color ..... | Taste .....

Ginger is used as a pleasant aromatic carminative, especially in mild cases of flatulency. Dose, 0.5 Gm.

Official preparations containing Zingiber are: the Extract, Fluidextract, Aromatic Fluidextract, Oleoresin, Syrup, and Tincture. It is also a constituent of Pulvis Aromaticum, and Pulvis Rhei Compositus.

GLANDULAR PREPARATIONS.

Pancreatinum, Pepsinum, Suprarenalum Siccum, Thyroideum Siccum.

Pancreatinum is an extract of the fresh pancreas of hog or of ox, and consists principally of the enzymes, amylopsin, trypsin and steapsin, with some inert material.

Pepsin is an extract of the fresh endogastrium of the hog, and consists principally of a proteolytic ferment.

Suprarenalum Siccum consists of the cleaned, dried, powdered suprarenal glands of various food animals. It should contain not less than 0.4% of epinephrine, the active pressor principle of the gland. In the British Pharmacopœia, a 1-1000 solution in N. S. is official, and is a convenient way of using the drug.

Thyroideum Siccum consists of the cleaned, dried, and powdered thyroid glands of food animals, and contains not less than 0.17% of iodine in thyroid combination.

Properties:

	Pancreatinum	Pepsinum	Suprarenal. sic.	Thyroid. sic.
Appearance				
Color				
Odor				
Taste				
Sol.: H_2O				
C_2H_5OH				
Ac. Tann. in aq. solut.				
Utility in medicine	Predigesting proteins, fats, and carbohyd.	Predigesting proteins; Treating Apepsia.	Inducing local anemia; By hypo, to elevate B. P.	Curative, Myxœdema, Cretinism.

Label 12 test-tubes A to L. In A, B, G and H place 6 mils each freshly prepared starch paste; in C, D, I and J place 6 mils each skimmed milk; in E, F, K and L place 6 mils olive oil. To A, C, E, G, I and K add 10 mg. each Na_2CO_3; to the others, add 0.2 mil each dil. HCl. To A to F inclusive add 5 mg. each pepsin; to the others add 10 mg. each pancreatin. Place all in a water bath kept at constant 40° C. After 30 minutes examine each test-tube, and note whatever changes may have occurred. Make appropriate tests of samples from each. Repeat after a further hour of enzyme activity.

Make suitable analytical tests:

	Pepsin		Pancreatin	
	½ hour	1½ hour	½ hour	1½ hour
A, G—Starch, alk.				
B, H—Starch, acid				
C, I—Milk, alk.				
D, J—Milk, acid				
E, K—Oil, alk.				
F, L—Oil, acid				

Identity of Unknowns:

Sample	Appearance	Color	Odor	Taste	Solubility H_2O	Solubility C_2H_5OH	Chem. Test	Identity
I								
II								
III								
IV								
V								
VI								
VII								
VIII								
IX								
X								
XI								
XII								
XIII								
XIV								
XV								
XVI								
XVII								
XVIII								
XIX								

PHARMACOPEDICS.

In this section the student acquires a desirable acquaintance with the different forms in which medicines are used, by personally making the different official preparations, and carefully noting their physical characteristics, the relative strength of allied preparations, the availability and desirability of the several different forms, the alkaloidal content where such is known, the leading utility of each preparation, and the average dose. So far as possible, ascertain the physical merits of each preparation. Endeavor, also, to acquire an identifying acquaintance with the selected preparations.

In the few required assays introduced, be not satisfied except with the most careful work. Let your scrupulousness in accuracy exemplify the way you expect to administer powerful drugs to those who will later place confidence in you. Acquire merited skill now.

Further reference may be had to the U. S. Pharmacopœia.

PART II.—PHARMACOPEDICS.

AQUÆ.

Aquæ are solutions of volatile substances in water. The volatile substance may be a liquid, a solid, or a gas.

Prepare official Aqua Cinnamomi as follows: Triturate together 0.2 mil oil of cinnamon and 0.15 Gm. purified talc; gradually add 100 mils distilled water, continuing the trituration. Filter and repeatedly refilter until filtrate is perfectly clear.

Properties of your preparation:

Appearance ..... | Taste .....

Color ..... | Reaction .....

Odor .....

Examine shelf samples of the following official Aquæ:

Sample	Color	Odor	Taste	Utility
Aqua				Solvent. Best agent to slake thirst
Aqua Ammoniæ, 10%				Limentum Ammoniæ; Spir. Ammon. Aromat.
Aqua Cinnamomi				Pleasant vehicle
Aqua Destillata				Laborat. solvent
Aqua Destill. Steril.				Intrav. inject.; hypo. use; collyria
Aqua Menthæ Piper.				Carminative; 15 mils
Aqua Rosæ Fortior				Ung. Aquæ Rosæ

Other official waters, having but limited utility, are: Aqua Ammoniæ Fortior (about 28% ammonia concentration), A. Amygdalæ Amaræ and A. Anisi (both superfluous), A. Aurantii Florum (for making Syrupus Aurantii Florum), A. Aurantii Florum Fortior (for making the preceding Aqua), A. Camphoræ, A. Chloroformi, A. Creosoti, A. Fœniculi, A. Rosæ, A. Aromatici (a saturated aqueous solution of volatile oils), A. Hamamelidis (a popular embrocation of doubtful value).

SYRUPUS.

Syrups are concentrated solutions of sugar in water or in aqueous liquids. They may be made extemporaneously by adding a medicated liquid to the official Syrup. Besides being a pleasant vehicle, Syrup is somewhat of a preservative of vegetable compounds, and tends to retard chemical changes in some readily oxidizable substances.

Prepare official Syrup as follows: With the aid of heat, dissolve 85 Gm. sugar in 45.5 mils distilled water; bring the liquid to the boiling point, strain, then pass enough distilled water through the strainer to make the product when cold equal 100 mils.

Properties of your Syrup:

Appearance	Taste .....
Odor	Sp. Gr. at 25° C. .....
Color	

Label 2 test-tubes thus: *Hypo-, Iso-, Hyper-.* Into each place 6 mils of your Syrup; then to the *Hypo-* add 3 mils H_2O; to the *Hyper-* add 2 Gm. sugar, heating in a water bath to complete solution. Set aside for several days, exposed to the air, and note results. (Put unused Syrup in stock bottle.)

1 Week:	2 Weeks:
Hypo-	*Hypo-* .....
Iso-	*Iso-* .....
Hyper-	*Hyper-* .....

Examine shelf samples of following official Syrups:

Sample	Odor	Color	Taste	Utility
Syrupus Acaciæ				Vehicle, resinous preparations
Syrupus Ac. Citrici				Vehicle, acid salts
Syrupus Ipecacuanhæ				Emetic; dose, 15 mils
Syrupus Prun. Virgin.				Vehicle, cough medicine
Syrupus Rhei Aromat.				Laxative; 10 mils
Syrupus Sarsap. Comp.				Vehicle for KI
Syrupus Sennæ				Purge for children; av. dose (adult), 4 mils
Syrupus Zingiberis				Vehicle, carminatives

Official Syrups of limited or no therapeutic utility: Syrupus Acidi Hydriodici, S. Aurantii, S. Aurantii Florum, S. Calcii Lactophosphatis, S. Ferri Iodidi, S. Hypophosphitum, S. Lactucarii, S. Picis Liquidæ, S. Rhei, S. Scillæ, S. Scillæ Compositus (Hive Syrup), S. Senegæ, S. Tolutanus.

SPIRITUS.

Spirits are hydroalcoholic or alcoholic solutions of volatile substances; and, while the greater number are solutions of volatile oils, a few represent solutions of volatile liquids, volatile solids, and gases.

Prepare the official Spiritus Aurantii Compositus as follows: Thoroughly mix 10 mils oil of orange, 2.5 mils oil of lemon, 1 mil oil of coriander, and 0.25 mil oil of anise, with enough alcohol to make a total of 50 mils. (Keep in a cool, dark place.)

Properties of your official Spirits:

Appearance ..... | Taste .....

Color ..... | Utility:

Odor ..... | Flavor for Elixir Aromaticum .....

Examine shelf samples of the following official Syrups:

Sample	Color	Odor	Taste	Utility
Spiritus Ætheris				Mild anodyne; 4 mils
Spir. Ætheris Nitrosi, Spirits of Nitre				Mild refrigerant; av. dose, 2 mils
Spir. Ammon. Aromat.				Briefly stimulative; av. dose, 2 mils
Spir. Aurantii Compos.				Flavor
Spir. Camphoræ				Counterirritant
Spir. Menthæ Piperitæ				Carminative

Spirits of limited utility in medicine: Spiritus Amygdalæ Amaræ, S. Anisi, S. Chloroformi, S. Cinnamomi, S. Juniperi, S. Juniperi Compositus, S. Lavandulæ, S. Menthæ Viridis, S. Glycerylis Nitratis (Nitroglycerin; dangerous to handle).

ELIXIRIA.

Elixirs are sweetened, aromatic, alcohol solutions. Because of the high alcohol content, they make good vehicles for the administration of tinctures and fluidextracts. They are not suitable as vehicles for the various salts, and are incompatible with chloral hydrate.

Prepare the official Elixir Aromaticum as follows: To 1.2 mils compound spirit of orange add enough alcohol to make 25 mils; then add 37.5 mils syrup, 10 mils at a time, shaking thoroughly after each addition; then in the same manner add 37.5 mils water. Next, intimately mix 3 Gm. purified talc with the above liquid, and filter through a wetted filter, refiltering until the filtrate is clear and transparent. Finally, wash the filter with 25% alcohol to make the total product equal 100 mils. (Place in stock, after examination.)

Properties of your Elixir, and of the other official Elixir:

Sample	Color	Odor	Taste	Utility
Elixir Aromaticum				Alcoholic vehicle
Elixir Glycyrrhizæ = Elix. Arom. + 14% Flex. Glycyrrhizæ				Vehicle for cough medicines

INFUSA.

Infusions are aqueous extracts of the water-soluble constituents of vegetable substances. They are usually made by treating the substance with boiling hot water; but if heat injures the vegetable principles, cold water may be substituted.

The weight of the drug used is 0.5% of the weight of the finished product.

Infusions should be freshly made, and discreetly used.

Prepare the official Infusum Digitalis as follows: Pour 50 mils boiling water on 1.5 Gm. bruised digitalis leaves. Allow it to macerate one hour. Then strain, add 15 mils cinnamon water, and pass enough distilled water through the residue on the strainer to make the product equal 100 mils. Mix well, place in a small bottle, and examine every week for one month.

Properties of your preparation, and the other official Infusion.

Sample	Color	Odor	Taste	Utility
Infusum Digitalis				Renal dropsy; 4 mils, cautiously
Infusum Sennæ Compositum				Cathartic; 120 mils

DECOCTA.

Decoctions are aqueous extracts of the water-soluble constituents of vegetable substances, extracted by boiling for 15 minutes. The standard formula for Decoctions makes the original weight of the drug represent 0.5% of the finished product; but with energetic substances this would be too strong.

Decoctions should be freshly made, and discreetly used.

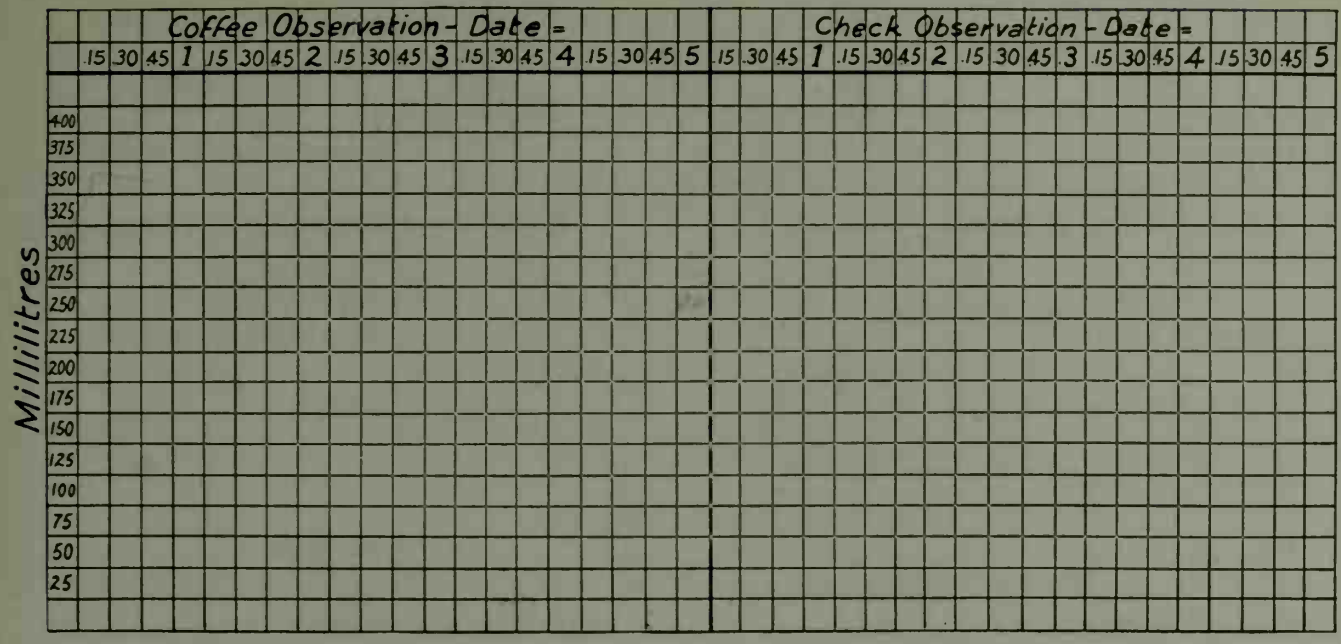
There are no official Decoctions.

Make a Decoction of coffee after the standard formula: Into a suitable covered vessel place 5 Gm. ground coffee; over it pour 100 mils cold water, cover it well, and boil for 15 minutes. Cool to 40° C., strain through thick cheese-cloth, expressing as much as possible; then pass enough cold water through the strainer to bring the product up to 100 mils.

Properties:

Sample	Color	Odor	Taste	Utility
Decoction of Coffee				Active diuretic

Heat your Decoction as hot as can be comfortably drunk. Void your urine. Drink the hot Decoction of coffee. Take hourly record of your kidney activity for the next five hours. Compare the resulting graph with a similar record taken some other day when no coffee is consumed.



LIQUORES.

Liquors are aqueous solutions of non-volatile substances. (*Cf.* Aquæ.) They may be made by simple solution of the substance in hot or cold water, or by chemical action.

Prepare the official Liquor Potassii Arsenitis (Fowler's Solution) as follows: Boil 1 Gm. arsenic trioxide and 2 Gm. potassium bicarbonate with 10 Gm. distilled water, in a tared flask, until solution is complete; then add enough distilled water to make the solution weigh 97 Gm.; then add 3 Gm. compound tincture of lavender, and filter through paper.

Qualities of your preparation:

Appearance ..... | Taste .....

Color ..... | Reaction .....

Odor .....

Examine shelf samples of the following official Liquors:

Sample	Color	Odor	Taste	Utility
Liquor Calcis = 0.17% $Ca(OH)_2$				Antacid; 15 mils
L. Cresolis Comp.				Antiseptic
L. Ferri Chloridi = 12.5% sol. $FeCl_3$				For making the tincture
L. Formaldehydi = 37% solution		Cautiously	Do not	Germicide. Tissue preservative
L. Hydrogenii Diox. = 3% sol. H_2O_2				Oxidizing disinfectant

Official Liquors (continued):

Sample	Color	Odor	Taste	Utility
L. Hypophysis				Smooth muscle stimulant
L. Iodi Compositus (Lugol's sol.)			Do not	Germicide and disinfectant
L. Magnesii Citratis				Aperient; 350 mils
L. Plumb. Subacet. Dil.				Protective
L. Potassii Arsenitis				St. Vitus' Dance, 0.1 mil
L. Potassii Citratis				Acidosis
L. Potassii Hydroxidi = 4.5% KOH			Do not	Caustic
L. Sodii Chloridi Physiologicus = 0.85% sol. NaCl				Vehicle for intravenous injection

Other official Liquors (these are relatively unimportant): Liquor Acidi Arsenosi, L. Ammonii Acetatis (Spirit of Mindererus), L. Arseni et Hydrargyri Iodidi (Donovan's Solution), L. Ferri et Ammonii Acetatis (Basham's Mixture), L. Ferri Subsulphatis (Monsell's Solution), L. Sodæ Chlorinatæ (Labarraque's Solution), L. Ferri Tersulphatis, L. Sodii Arsenatis, L. Sodii Glycerophosphatis, L. Sodii Hydroxidi, L. Zinci Chloridi.

LINIMENTA.

Liniments are liquid preparations, usually of an oily or soapy nature, intended for external use as embrocations.

Prepare the official Linimentum Saponis as follows: In 70 mils alcohol dissolve 4.5 Gm. camphor and 1 mil oil of rosemary; add 6 Gm. powdered soap, and enough water to make the product measure 100 mils. Shake the mixture until the soap is dissolved, set it aside for 24 hours, then filter.

Try using some on yourself, and note how it facilitates the various massage movements,.....

How does your sample compare with the standard?.....

Examine the following official Liniments:

Sample	Color	Odor	Taste	Utility
L. Ammoniæ, 25% NH_4OH			Do not	Rubefacient
L. Belladonnæ				Sedative locally (?)
L. Calcis (Carron Oil)				Protective in burns
L. Camphoræ (20%)				Mild counterirritant

Official Liniments (continued):

Sample	Color	Odor	Taste	Utility
L. Chloroformi (30%)				Rubefacient
L. Saponis (Opodeldoc)				Embrocant
L. Saponis Mollis (Tinct. Green Soap)				Good detergent
L. Terebinthinæ				Sharp rubefacient

MUCILAGINES.

Mucilages are aqueous solutions of the viscid, gummy principles of some vegetable substances. Their principal uses are for the preparation of emulsions, and as excipients in pills.

They do not keep well, especially in warm weather.

Prepare the official Mucilage of Acacia as follows: In a flask place 20 Gm. acacia in small fragments; wash with cold water, then drain. Add 40 mils warm distilled water, stopper container, and frequently agitate contents until the gum is all dissolved; then strain through cheese-cloth.

Note present properties, and keeping properties:

	Appearance	Color	Odor	Taste	Reaction
Mucil. Acac.; fresh:					
1 week					
2 weeks					
3 weeks					
4 weeks					

The other official Mucilage is Mucilago Tragacanthæ.

EMULSA.

Emulsions are aqueous preparations wherein oils or resins are maintained in a fine state of subdivision and suspension by means of the presence of mucilaginous or other viscid substances.

Prepare the official Emulsum Olei Terebinthinæ as follows: Into a perfectly dry flask introduce 15 Gm. acacia, in fine powder; add 15 mils rectified oil of turpentine, and 5 mils expressed oil of almond, and agitate the mixture thoroughly. Next add 30 mils water, mixing this in with vigorous shaking. When emulsification is complete add 25 mils of syrup in 5-mil portions, shaking thoroughly between each addition. In

the same manner, next add successive portions of water until the product measures 100 mils.

This preparation provides the best medium for administering "Spirits of Turpentine" in those rare instances where its internal use seems indicated. Dose, 2 mils.

Properties of your Emulsion:

Appearance .....
Color .....
Odor .....
Taste .....
Microscop. appearance .....

Three other Emulsions are official:

Sample	Color	Odor	Taste	Utility
E. Amygdalæ				Vehicle and cosmetic
E. Asafœtidæ				No utility
E. Olei Morrhuæ				A discarded preparation

PULVERES.

Powders are triturated mixtures of dry medicinal substances. Except for Seidlitz Powder, the official powders are all insoluble.

Prepare the official Pulvis Cretæ Compositus as follows: Thoroughly mix by trituration 2 Gm. finely powdered acacia, 5 Gm. powdered sugar, and 3 Gm. prepared chalk. When intimately mixed, pass through a No. 60 sieve. (Reserve for next group.)

Examine the following official Powders:

Sample	Color	Odor	Taste	Utility
P. Aromaticus				A flavor
P. Cretæ Compositus				Antacid
P. Effervescens Comp. (Seidlitz Powder)				Aperient; dose, 1 set of 2 powders
P. Glycyrrhizæ Comp.				Laxative; 4 Gm.
P. Ipecac. et Opii (Dover's Powder)				Abortant for "colds"; 0.5 Gm.
P. Jalapæ Comp.				Vigorous purge; 2 Gm.
P. Rhei Compositus (Gregory's Powder)				Sharp cathartic; av. dose, 2 Gm.

Make trial Seidlitz Powders as follows: Mix 15 Gm. dry, finely powdered sodium bicarbonate intimately with 45 Gm. dry, finely powdered potassium and sodium tartrate. Divide the mixture into 6 equal parts, and wrap each part in a separate blue paper.

Divide 13 Gm. dried, finely powdered tartaric acid into 6 equal parts, and wrap each part in a separate white paper.

Keep these powders in a dry, well-protected container. Take one or two doses, mixed in water, before breakfast, and note effect.

MISTURÆ.

Mixtures are aqueous preparations containing insoluble substances, or those but partly soluble. They are not to be filtered or strained, but are to be dispensed with a "Shake" label.

Prepare the official Mistura Cretæ as follows: To 5 Gm. compound chalk powder in a mortar *gradually* add 10 mils cinnamon water, triturating the mixture until it is uniform. Transfer to a graduate, and add water rinsings from the mortar until the product measures 25 mils.

Appearance	Odor .....
Color	Taste .....

Mistura Cretæ was formerly a favorite antacid, but has fallen somewhat into disuse. The average dose is 15 mils, using a freshly prepared mixture only. Take a single dose of your preparation, 3 hours after meals, and note effects,.....

The other official Mixture is Mistura Glycyrrhizæ Composita, or "Brown Mixture"—an antiquated, ridiculous, "shot-gun" conglomeration, containing at least 15 different ingredients. It should be discarded forthwith.

MASSÆ.

Masses are solid preparations of such soft cohesiveness that they may be formed readily into pills.

Prepare the official Massa Ferri Carbonatis (Vallet's Mass) as follows: Dissolve 10 Gm. ferrous sulphate in 20 mils boiling, distilled water; add 2 mils syrup; filter, and let cool. Dissolve 4.6 Gm. monohydrated sodium carbonate in 20 mils boiling distilled water, filter, and let cool. When both solutions are cold, place the sodium solution in a flask of 50 mils capacity, and gradually add the iron solution, agitating frequently until there is no further evolution of carbonic gas. Fill the flask with distilled water, cork, and set aside until the subsidence of the ferrous carbonate is complete. Pour off the supernatant liquid, and, by decantation, wash the salt with a mixture of syrup, 1 part, and distilled water, 19 parts, until the washings no longer have a salty taste. Drain the precipitate on a cloth strainer, express all the water possible, and mix with the precipitate 3.8 Gm. clarified honey and 2.5 Gm. sugar; then, with constant stirring, evaporate in a tared dish over a water bath, until the completed product weighs 10 Gm.

This preparation should contain not less than 35% $FeCO_3$.

Properties of your preparation, and of the other official Mass.:

Sample	Color	Odor	Taste	Utility
M. Ferri Carb.				Extemp. iron administration; av. dose, 0.25 Gm.
M. Hydrargyri				Undesirable form for the administ. of mercury

PILULÆ.

Pills are medicinal substances formed into ovate, oblate, or spheroidal solids, of such size and consistency as to be easily swallowed whole. When they contain medicaments readily changeable in air, pills are usually coated with sugar or gelatin; but they may be coated with keratin when the medicament is intended for intestinal action rather than for gastric.

Prepare the official Pilulæ Aloes as follows: Intimately mix 1.3 Gm. finely powdered aloes with an equal weight of pulverized soap. Incorporate just enough water to make a pilular mass. Roll the mass out into a long even cylinder, and divide it into 10 equal parts; roll each part into a spheroid.

The following Pills are official:

Pilulæ Aloes. Dose 2 pills, each containing 0.13 Gm. aloes. Purge.

Pilulæ Asafœtidæ. Dose, 2 pills. Each contains 0.2 Gm. asafœtida. Of little or no therapeutic value.

Pilulæ Catharticæ Compositæ. Dose, 2 pills. Each contains 0.08 Gm. ex. colocynth comp., 0.06 Gm. calomel, 0.02 Gm. jalap, and 0.015 Gm. gamboge. A drastic, griping purge.

Pilulæ Ferri Carbonatis. Dose, 2 pills. Each contains 0.06 Gm. $FeCO_3$. Excellent for anæmia. (Blaud's Pill.)

Pilulæ Ferri Iodidi. Dose, 2 pills. Each contains 0.065 Gm. ferrous iodide. Reduces readily. Used for syphilitic anæmia.

Pilulæ Phosphori. Dose, 1 pill. Each contains 0.6 mg. phosphorus. Sometimes used in certain cases of rachitis.

Pilulæ Rhei Compositæ. Dose, 2 pills. Each contains 0.13 Gm. rhubarb and 0.1 Gm. aloes. A strong cathartic.

Cut open a sample of each Pill and report:

Sample	Color	Odor	Taste	How identified
Pil. Aloes				
Pil. Asafœtidæ				
Pil. Catharticæ Comp.				
Pil. Ferri Carb.				

Cut open a sample of each pill and report (continued):

Sample	Color	Odor	Taste	How Identified
Pil. Ferri Iodidi				
Pil. Phosphori				
Pil. Rhei Comp.				

Dissolve 3 Pills of ferrous carbonate in 15 mils dil. H_2SO_4; add 85 mils distilled water. Titrate immediately with tenth-normal $K_2Cr_2O_7$ V. S., using $K_4Fe(CN)_6$ as indicator. Each mil of titer used corresponds to 0.011584 Gm. $FeCO_3$.

What is the strength of your sample?.....

UNGUENTA.

Ointments are fatty preparations of such consistency as to melt and spread rapidly at body temperatures. Formerly extensively used as protective surgical dressings, they are now principally employed for the treating of skin affections, and for inunctions.

Make the official Unguentum Hydrargyri Ammoniati as follows: Melt 25 Gm. white petrolatum; take 5 Gm. of it and rub it thoroughly with 5 Gm. finely powdered ammoniated mercury; then add the balance of the petrolatum and 20 Gm. hydrous wool fat; mix thoroughly, and continue stirring the mixture until it congeals.

Appearance ..... | Odor .....

Color ..... | Consistency .....

Examine the following official Ointments:

Sample	Strength	Color	Odor	Utility
Unguentum				Base
Ung. Aquæ Rosæ				Favorite cosmetic
Ung. Belladonnæ	0.0125%			Local sedative (?)
Ung. Chrysarobini	6%			For psoriasis
Ung. Hydrargyri Dil. (Blue ointment)	30%			Pediculosis pubis, but the Oleate is better
Ung. Hydrargyri Ammon.	10%			Wet eczemas
Ung. Hg. Oxidi Flavi	10%			Blepharitis
Ung. Picis Liquidæ	50%			For weeping eczemas
Ung. Sulphuris	15%			Specific in scabies
Ung. Zinci Oxidi	20%			A drying ointment

Other official Ointments, but of limited utility, are: Ung. Acidi Borici, 10%; Ung. Acidi Tannici, 20%; Ung. Diachylon, of pharmaceutical interest chiefly; Ung. Gallæ, 20%; Ung. Hydrargyri, 50%, a base; Ung. Hydrargyri Nitratis, 7%, citrine ointment; Ung. Iodi, 4%; Ung. Iodoformi, 10%, an abomination; Ung. Phenolis, 2%, formerly in much favor; Ung. Stramonii, 20%, superfluous.

CERATA.

Cerates are unctuous fatty preparations, similar to ointments, but having a higher melting point, and not liquefying at the body temperature.

Prepare the official Ceratum as follows: By the heat of a water bath melt 30 Gm. white wax, add 70 Gm. benzoinated lard; continue heat until all is melted; strain through thin cheesecloth, and stir constantly until the mixture congeals. (For hot localities a greater percentage of wax may be necessary.)

How does the consistency of the Cerate compare with an ointment?.....

Two other Cerates are official: Ceratum Cantharidis, which belongs to a discarded therapeutics; and Ceratum Resinæ, used in making Linimentum Terebinthinæ.

EMPLASTRA.

Plasters are solid, adhesive preparations, spread on some fabric, and usually requiring warming before being applied to the body.

Prepare as follows a satisfactory substitute for the official Emplastrum Sinapis: To 8 Gm. flour add 4 Gm. mustard; mix thoroughly, then add just enough warm water (*not* hot) to make a soft smooth paste. Spread this on heavy paper or on cottoncloth.

Bind some of your prepared Mustard Plaster on the flexor surface of your forearm, and leave it there until distinctly sharp sensations are perceived. Remove plaster, and examine appearance of the skin. Report:.....

Time taken for effect:.....

Nature of effect:.....

Duration of effect:.....

The following Plasters are official:

Sample	Strength	Utility
Emplastrum Belladonnæ	0.35%	Local sedative (any effect doubtful)
Emplastrum Cantharidis	0.1%	Vesicant; *very* seldom indicated
Emplastrum Capsici		Rubefacient and vesicant
Emplastrum Elasticum		Surgeons' adhesive plaster
Emplastrum Plumbi		Base for resin plaster
Emplastrum Resinæ		Cutaneous macerant
Emplastrum Sinapis		Counterirritant

GLYCERITA.

Glycerites consist of solutions of medicinal substances in glycerin.

Prepare the official Glyceritum Amyli as follows: Triturate 5 Gm. starch with 5 mils water until a smooth homogeneous mixture is produced. Then gradually add 40 Gm. glycerine that has been heated to 140° C. in a porcelain dish. With constant stirring, continue applying heat, not above 144° C., until a translucent jelly is produced.

Properties of Glyceritum Amyli:

Appearance .....
Color .....
Odor .....
Taste .....

Feel .....
Utility:
Demulcent and emollient .....

The other official Glycerites are as follows:

Sample	Strength	Color	Odor	Utility
G. Acidi Tannici	20%			Astringent emollient
G. Boroglycerini	31%			Surface depletant
G. Hydrastis	1.25%			Stimulant depletant
G. Phenolis	20%			Indurant; dangerous
Unofficial: G. Ichthyol	20%			Erysipelas

SUPPOSITORIA.

Suppositories are conical, cylindrical, or spheroidal preparations made by combining medicinal substances with some other substance, like glycerinated gelatin or cacao butter, that melts but slowly at body temperatures. They are used to favor prolonged application of medicines to the walls of the various body cavities.

Make the official Suppositoria Glycerini as follows: Dissolve 0.05 Gm. monohydrated sodium carbonate in 0.5 mil water; add 2.7 mil glycerin and 0.2 Gm. stearic acid; cover, and heat the mixture over a water bath until all the CO_2 has been driven off and the liquid is clear (15 minutes or more). Then pour the material into a suitable mold (a small conical graduate will do); cool in flowing water, and, when it is firm, remove from the mold and examine.

What is its appearance?.....

How does it feel?.....

Make a Suppository as follows: To 0.5 Gm. tannic acid add an equal quantity of well-grated oil of theobroma; mix the two thoroughly in a mortar; then add a small amount of melted oil of theobroma; mix well; and as congelation is about to take place pour the material into a suitable mold. Cool until set; remove, and examine.

Make a Suppository as follows: Dissolve 1 mil ichthyol in 3 Gm. glycerine; add 5 Gm. melted glycerinated gelatine; mix the ingredients thoroughly, and at once pour into a small test-tube which has been coated internally with a very thin film of liquid petrolatum. Cool until Suppository is firmly set. (Keep in tightly closed containers in a cool place.)

Compare the merits of these three Suppositories:

Suppository A: .....

Suppository B: .....

Suppository C: .....

Also take 1 Gm. pieces from each, and compare their melting periods when immersed in water of a temperature of 38° C.

A: ..... B: ..... C: .....

OLEATA.

An Oleate is a solution of an alkaloid or of an oxide in oleic acid.

Prepare the official Oleatum Hydrargyri as follows: In a tared porcelain dish place 2.5 Gm. finely powdered yellow mercuric oxide, and 2 mils alcohol; mix well; then add 7.5 Gm. oleic acid; warm the mixture over a water bath to a temperature *not exceeding* 50° C., stirring constantly with a glass rod until the alcohol is expelled and the mercuric oxide is entirely dissolved. Then add enough oleic acid to make the product weigh 10 Gm. Mix thoroughly.

This Oleate has to be kept in tightly closed containers, well protected from light. It should not be used if globules of metallic mercury are visible.

Properties of Oleatum Hydrargyrum:

Freshly made:	After 1 month:	After 2 months:
Sample	Sample	Sample .....
Appearance	Appearance	Appearance .....
Consistency	Consistency	Consistency .....
Color	Color	Color .....
Odor	Odor	Odor .....
Visible Hg.	Visible Hg.	Visible Hg. .....

The Oleate of Mercury is more elegant and efficient than the corresponding ointment, especially in the treatment of pediculosis.

COLLODIA.

A Collodion is a solution of pyroxylin (gun-cotton) in a mixture of ether and alcohol. It is a highly inflammable liquid. When applied to a surface, the solvent evaporates, leaving deposited a transparent, tenacious film.

Prepare the official Collodium as follows: In a bottle place 2 Gm. pyroxylin, add 12.5 mils alcohol; thoroughly shake the mixture; then add 37.5 mils ether, and shake

this mixture until the pyroxylin is dissolved. Cork the bottle tightly, setting it aside until the liquid has cleared; then decant the clear portion, place in a suitable bottle, and cork tightly.

All these operations must be conducted away from the vicinity of any flame.

Prepare the official Collodium Flexile as follows: Tare a small bottle, and into it place 19 Gm. Collodion, 0.4 Gm. camphor, and 0.6 Gm. castor oil; shake the mixture until the camphor is dissolved.

This preparation should be kept in well-stoppered bottles, in a cool place, and well removed from the fire.

Properties of Collodia,.....

Paint one knuckle with Collodion, and an adjacent knuckle with Flexible Collodion. On flexor surface of forearm, paint comparative areas with the two in the same way.

Collodium:	Collodium Flexile:
Sample	Sample .....
Appearance	Appearance .....
Color	Color .....
Odor	Odor .....
Flexibility	Flexibility .....
Adhesiveness	Adhesiveness .....
Contraction	Contraction .....

Collodia are used as adhesive protectives; also to render cotton dressings more concrete and impervious. They are being in part supplanted by the new flexible paraffin dressings.

There is one other official Collodion: Collodium Cantharidatum. This is an obsolescent preparation, well deserving complete discard.

FLUIDEXTRACTA.

Fluidextracts are liquid preparations of vegetable drugs, so made that 1 mil of the liquid preparation represents the medicinal activity of 1 Gm. of the powdered drug.

With four exceptions (Cascara, Frangula, Glycyrrhiza, and Triticum), they are extracts of those vegetable principles that are soluble in alcohol. The four exceptions are more akin to infusions, being water extracts; but they each have alcohol added as a preservative.

There are four different methods of preparing Fluidextracts: three by percolation, and one by percolation and infusion. In making these preparations, the rate of percolation should not exceed 10 drops a minute for the reserved portion, and 20 drops a minute thereafter. It is usually assumed that 3000 mils of percolate will exhaust 1000 Gm. powdered drug.

Prepare the official Fluidextractum Podophylli by "Type Process A" as follows: Place 100 Gm. podophyllum, in No. 40 powder, in a mortar; render it evenly and decidedly damp with alcohol; place it in a percolator, and leave it tightly covered for 6 hours. Then saturate it with alcohol, and when the alcohol begins to drip from the

percolator, insert a cork, add enough alcohol so a stratum lies above the saturated powder; cover tightly, and let maceration proceed for 48 hours. Then permit percolation to proceed, adding more alcohol until the drug is exhausted. The first 85 mils of the percolate are to be set aside as a reserved portion; the balance is to be concentrated over a water bath, at a temperature not exceeding 60° C., until it is of a pasty consistency. (If all the percolate had thus been concentrated, the resulting paste would constitute the Extract.) Dissolve this paste in the reserved portion; then add enough alcohol to make the total quantity equal 100 mils.

Note: Appearance ..... Color ..... Taste .....

Prepare the official Fluidextractum Ipecacuanhæ, by "Type Process B," as follows: Prepare a preliminary menstruum of 10 mils dil. HCl, 20 mils alcohol, and 20 mils water; with this menstruum moisten 100 Gm. ipecac, in No. 60 powder, sufficiently to render it evenly and distinctly damp; place it loosely in a percolator, cover tightly, and permit maceration to continue for six hours. Then pack firmly, add balance of the menstruum, and when this has disappeared from the surface, gradually add 40% alcohol, keeping a stratum constantly above the drug. When the liquid begins to escape from the percolator, stopper, cover closely, and let maceration proceed for 48 hours. Then allow the percolation to proceed slowly, gradually adding the 40% alcohol until drug is exhausted. Reserve the first 80 mils of the percolate. Recover the alcohol from the remainder, and then evaporate it to a soft extract at a temperature not exceeding 60° C.; dissolve this paste in the reserved portion, and add enough 40% alcohol to make the total equal 100 mils. (For method of assay, see U. S. P. IX, 188.)

Note: Appearance ..... Color ..... Taste .....

Prepare the official Fluidextractum Aconiti, "Type Process C," as follows: Divide 100 Gm. aconite, in No. 40 powder, into three portions, in the ratio of 5: 3: 2. Moisten the 50 Gm. portion with enough 75% alcohol to make it evenly and distinctly damp, and to so maintain it after six hours maceration in a tightly covered container. Then pack it loosely in a percolator, saturate it with alcohol, so that a stratum of the menstruum covers the powder. Cork the lower orifice as soon as the liquid begins to appear there, cover the percolator, and permit maceration to continue for 48 hours. Then allow percolation to proceed, gradually adding more alcohol. Reserve the first 20 mils of the percolate, and collect 150 mils more in successive 30-mil portions.

Repeat the above process with the 30 Gm. aconite, using for the menstruum adequate amounts of the 30-mil portions in the order collected, or additional alcohol if necessary. Reserve the first 30 mils of the percolate, adding it to the first 20 mils reserved from the earlier percolation. Collect 80 more mils in successive 20-mil portions.

Repeat this same process with the 20-Gm. portion of aconite, using the preceding 20-mil portions of percolate for menstruum. Collect 50 mils of the percolate from this third lot, and add it to the first reserves of the other percolations, making 100 mils finished product. (However, in Type C cases, where a definite assay is possible, the procedure recommended in the U. S. P. is to collect but 42 mils of this third percolate, to add this to the previous reserved portions, to then assay an aliquot part, and to finally adjust the addition of further percolate, so that each mil of the finished Fluidextract

shall contain the prescribed amount of alkaloid. This alkaloidal strength, in the case of aconite, must be not less than 0.45 mg., nor more than 0.55 mg., per millilitre. For assay see U. S. P. IX, 177.)

Note: Appearance ..... | Smell .....
Color ..... | Taste .....

Make the official Fluidextractum Cascaræ Sagradæ "Type Process D," as follows: To 100 Gm. cascara sagrada, in No. 40 powder, add 500 mils boiling water; mix thoroughly, cover, place in a warm place, and permit maceration to continue for two hours; then transfer to a metallic percolator, and allow percolation to proceed, gradually adding extra amounts of boiling water until the drug is exhausted. Over a water bath evaporate the percolate to 75 mils. Cool, and add 25 mils alcohol to complete the product.

Note: Appearance ..... | Odor .....
Color ..... | Taste .....

Fluidextracts should be kept tightly stoppered in amber-colored bottles, protected from the sunlight and extreme temperature changes. If after one month sedimentation occurs, the clear portion should be decanted, the part remaining should be filtered, and the filtrate thoroughly mixed with the decantate.

There are 49 official Fluidextracts, the majority of which are superfluous, inert, or obsolete.

Properties of the more useful official Fluidextracts:

Sample	Process	Ave. alk. cont.	Odor	Color	Taste	Utility
Flex. Aconiti	C	0.5%				Cardiac depressant; av. dose, 0.03 mil
Flex. Belladonnæ Radicis	A	0.45%				Antispasmodic; av. dose, 0.05 mil
Flex. Cannabis	A					Quietant; 0.1 mil
Flex. Cascaræ Sag.	D					Laxative, 1 mil
Flex. Digitalis	A					Cardiac tonic, 0.05 mil
Flex. Ergotæ	B					Oxytocic, 2 mils
Flex. Hydrastis	B	2%				Stim. astringent, 2 mils
Flex. Hyoscyami	A	0.06%				Sedative (hyoscin); av. dose, 0.2 mil
Flex. Ipecacuanhæ	B	2%				Emetic, 1 mil

Properties of the more useful official Fluidextracts (continued):

Sample	Process	Ave. alk. cont.	Odor	Color	Taste	Utility
Flex. Podophylli	A					Purgative, 0.5 mil
Flex. Rhei	A					Cathartic, 1 mil
Flex. Sennæ	A					Cathartic, 1 mil
Flex. Viburni Prunifolii	A					Uterine sedative (?); av. dose, 2 mils

Official Fluidextracts which are superfluous, either because some other preparation of the same drug, or some other drug, is eminently superior: Flex. Aurantii Amari, Flex. Cascaræ Sagradæ Aromaticum, Flex. Cimicifugæ, Flex. Cinchonæ, Flex. Eucalypti, Flex. Frangulæ, Flex. Glycyrrhizæ, Flex. Granati, Flex. Nucis Vomicæ, Flex. Pilocarpi, Flex. Spigeliæ, Flex. Zingiberis.

Official Fluidextracts which are practically inert: Aromaticum Eriodictyi, Gentianæ, Rosæ, Sabal, Sarsaparillæ, Sarsaparillæ Compositum, Stillingiæ, Sumbul, Taraxaci, Tritici, Uvæ Ursi, Xanthoxyli.

Official Fluidextracts which are obsolete: Aspidospermatis, Buchu, Colchici Seminis, Gelsemii, Grindeliæ, Guaranæ, Lobeliæ, Scillæ, Senegæ, Staphisagriæ, Veratri Viridis.

EXTRACTA.

An Extract is the concentrated residue obtained by evaporating the percolate, or other exhaust, of a vegetable drug. According to the degree of evaporation, Extracts appear in two forms: the Pilular Extract, of semisolid, pasty consistency; and the Powdered Extract, consisting of fine, dry powder. Such as are capable of reliable assay have a definite percentage of alkaloidal content.

Prepare the official Extractum Belladonnæ Foliorum as follows: Moisten 100 Gm. No. 40 powder, belladonna leaves with 75% alcohol; pack it firmly in the percolator; saturate it with the menstruum, providing a supernatant stratum. Macerate the powder for 48 hours; then permit percolation to proceed until the percolate equals 300 mils. Distill off the alcohol, and evaporate the residue with frequent stirring, until the substance is of a pasty consistency, being careful that at no time shall the temperature exceed 70° C. Mix the mass thoroughly, and then weigh it. By assay (see below), determine its alkaloidal content, calculate the total alkaloids in the prepared extract, then thoroughly mix in enough glucose to make the total product contain 1.25% of the alkaloids of belladonna leaves.

Assay. In 10 mils diluted alcohol dissolve 2 Gm. pilular extract of belladonna leaves (made above). Place the solution in a separator, adding thereto repeated rinsings of the first vessel used, utilizing for this wash 10 mils of distilled water mixed with 2 mils NH_4OH. Repeatedly shake out the extract solution with chloroform; then use weak H_2SO_4 to extract the alkaloids from the chloroform by repeated shakings out. Place the acid washings in a separator, render the solution distinctly alka-

line to litmus, using NH_4OH, and again extract the alkaloids by repeated shaking out with chloroform. Now evaporate the chloroform solutions to dryness; treat the alkaloids, contained in the residue, with 5 mils of ether; evaporate to dryness; treat again with 5 mils ether, and again evaporate to dryness; then dissolve in exactly 5 mils tenth-normal H_2SO_4 V. S., and titrate the excess of acid with fiftieth-normal KOH V. S., using cochineal T. S. as indicator.

Each mil of titer consumed corresponds to 28.92 milligrams of the alkaloids of belladonna leaves.

Properties of your Extract of Belladonna Leaves:

Appearance ..... | Odor .....

Color ..... | Taste .....

Weight of your Extract (to milligrams), ...

Amount of titer used, ...

Total alkaloids in 2 Gm. sample, ...

Total alkaloids in your Extract, ...

Amount of glucose to be added, ...

Alkaloidal content of finished Extract, ...

Prepare the official Powdered Extract of Rhubarb as follows: Moisten 100 Gm. No. 40 powdered rhubarb with sufficient 80% alcohol; place it in a percolator; saturate it so a stratum of the menstruum remains above; macerate it for 48 hours. Then percolate it slowly, so as to obtain 300 mils. Distill off the alcohol, evaporate the residue, at as low a temperature as possible, to a syrupy consistency. Place this in a shallow dish, adding thereto rinsings from the still (using for this purpose 80% alcohol); stirring frequently, evaporate this mixture to dryness, being careful the temperature never exceeds 70° C. Weigh the dry extract; add thereto 5 Gm. magnesium oxide, and enough freshly dried starch to make the product weigh 50 Gm. Mix thoroughly, reducing the mixture to a fine powder; pass this through a No. 60 sieve, and transfer it to a tightly stoppered bottle.

Note: Appearance ..... | Odor .....

Color ..... | Taste .....

There are 25 official Extracts, the majority of which are powerful preparations. They are made on a large scale by the manufacturers of pharmaceutical supplies, the pilular extracts being extensively used in pill masses and in ointments. As they rarely appear in other form their physical properties need not be studied at this time.

Preparation	Alk. Cont. Ave.	Utility	Dose
Ext. Aconiti	2%	Cardiac depressant	0.01 Gm.
Ext. Belladonnæ Foliorum	1.25%	Antispasmodic	0.015 Gm.
Ext. Cannabis		Quietant and soporific	0.01 Gm.
Ext. Cascaræ Sagradæ	1 to 3	Laxative	0.25 Gm.
Ext. Colocynthidis	1 to 4	Purgative	0.03 Gm.
Ext. Colocynthidis Comp.		Drastic purge	0.25 Gm.
Ext. Fellis Bovis	1 to 8	Cholagogue (?)	0.1 Gm.
Ext. Hydrastis	10%	Stimulant to mucosa	0.5 Gm.
Ext. Nucis Vomicæ	15.5%	Spinal tonic and irritant	0.015 Gm.
Ext. Opii	20%	Narcotic and analgesic	0.03 Gm.
Ext. Rhei	1 to 2	Laxative	0.25 Gm.

Of less importance, or superfluous, are the official Extracts of Cimicifuga, Colchicum Corm, Ergot, Gelsemium, Gentian, Glycyrrhiza, Hyoscyamus, Malt, Physostigma, Stramonium, Sumbul, Taraxacum, and Viburnum Prunifolium.

TINCTURA.

Tinctures are alcoholic preparations made by extraction of the important medicinal principles of vegetable drugs. Two exceptions are the Tincture of Iodine and Ferric Chloride, which are alcoholic solutions of chemical substances.

Of the more potent drugs, the strengthof the Tincture is such that 100 mils of the finished product represents 10 Gm. of the drug. The majority of Tinctures are prepared by percolation, a few by maceration, and a few others require special methods. All Tinctures should be kept in tightly stoppered bottles, free from light, and in a cool place.

Prepare the official Tinctura Opii Camphorata by "Type Process M" (maceration): Make a menstruum of 5 mils glycerin mixed with 120 mils dilute alcohol; in this place 0.5 Gm. each of powdered opium, benzoic acid, and camphor, and 0.5 mil oil of anise. Set it in a moderately warm place, allowing maceration to proceed for 3 days, occasionally agitating the mixture. Transfer to a filter, collect the filtrate, and wash the residue with dilute alcohol to make the total product equal 125 mils.

Note: Appearance ..... | Odor .....

Color ..... | Taste .....

(Instead of the above the Compound Tincture of Lavender may be used for study).

Prepare the official Tinctura Rhei Aromatica by "Type Process P" (percolation): Mix 30 Gm. rhubarb, 6 Gm. saigon cinnamon, 6 Gm. clove, and 3 Gm. myristica (all in No. 40 powder). Make a menstruum consisting of 15 mils glycerin, 75 mils alcohol, and 60 mils water; with this mixture make the combined powders evenly and distinctly damp, transfer to a percolator, and let stand covered for 6 hours; then pack it firmly, saturate it with the menstruum so a stratum of liquid lies above the powders. Close lower orifice, cover tightly, and let maceration continue 24 hours. Then permit percolation to proceed slowly, gradually adding enough dilute alcohol to make the total equal 150 mils.

Note: Appearance ..... | Odor .....

Color ..... | Taste .....

In 15 mils of this Aromatic Tincture of Rhubarb dissolve 0.1 Gm. potassium carbonate; then add 85 mils syrup; mix thoroughly.

Is the product (aromatic syrup of rhubarb) acceptable to taste and smell?

.....

There are 54 official Tinctures. Of this large number, two are really liquors (Iodine and Ferric Chloride); fifteen are mere flavoring agents, of which six only are of much use; fourteen of the Tinctures have a well-recognized utility; while the remaining thirty-two might as well be discarded.

Group A consists of the recognizedly useful Tinctures, all of which are of 10% strength, except the Tinctures of Hydrastis and Rhubarb, which are 20%.

Sample	Alkaloid Cont.	Color	Odor	Taste	Utility
Tinct. Aconiti	0.05%				Cardiac depressant; av. dose, 0.3 mil
Tinct. Belladonnæ Fol.	0.03%				Antispasmodic; 0.7 mil
Tinct. Benzoini Comp.					Laryngitis; inhalant
Tinct. Cannabis					Sedative; 0.75 mil
Tinct. Colchici Seminis	0.04%				Antirheumatic (?); av. dose, 2 mils
Tinct. Digitalis					Cardiac tonic and irritant; 0.5 mil
Tinct. Hydrastis	0.4%				Mucosa stimulant; 4 mils
Tinct. Hyoscyami	0.006%				Sedative; 2 mils
Tinct. Nucis Vomicæ	0.25%				Spinal excitant; 0.5 mil
Tinct. Opii	1%				Narcotic; 0.5 mil

Group A (continued):

Sample	Alkaloid Cont.	Color	Odor	Taste	Utility
Tinct. Opii Camphorata Paregoric	0.05%				Sedative and soporific; av. dose, 4 mils
Tinct. Opii Deodorati	1%				Sedative, less narcotic; 0.5 mil
Tinct. Physostigmatis	0.015%				Stimulant to parasympathetic; 1 mil
Tinct. Rhei Aromatica					Purge for children; av. dose, 2 mils

Group B: The two hydro-alcoholic solutions:

Sample	Iron Cont.	Color	Odor	Taste	Utility
Tinct. Ferri Chloridi	4.48%				Corrosive hematinic; 0.5 mil (obsolescent)
Tinctura Iodi (1, 7% + KI, 5%)					Counterirritant and surface disinfectant

Group C: Useful flavoring tinctures:

Sample	Drug Cont.	Color	Odor	Taste	Utility
Tinct. Aurantii Dulcis					In Syrupus Aurantii
Tinct. Cinnamomi					Carminative, 2 mils
Tinct. Gentianæ Comp.					Vehicle
Tinct. Lavandulæ Comp.					In Fowler's Solution
Tinct. Limonis Corticis					General flavor
Tinct. Zingiberis					Carminative

Group D: Superfluous flavoring Tinctures: Aurantii Amari, Cardamomi, Cardamomi Composita, Moschi, Myrrhæ, Tolutana, Valerianæ, Valerianæ Ammoniata.

Group E: 10% Tinctures of limited or doubtful utility: Aloes, Cantharidis, Capsici, Cinchonæ Composita, Gelsemii, Kino, Lobeliæ, Sanguinariæ, Scillæ, Stramonii, Veratri Viridis.

Group F: 20% Tinctures of limited or doubtful utility: Arnicæ, Asafœtidæ, Benzoini, Calumbæ, Cinchonæ, Guaiaci, Guaiaci Ammoniata, Lactucarii (50%), Pyrethri, Quassiæ, Rhei.

RESINA.

Resins are precipitates from strong alcoholic extracts of water-insoluble principles. They usually contain the major portion of the active principles of the drug.

Prepare the official Resina Podophylli as follows: Moisten 200 Gm. podophyllum, No. 60 powder, with 100 mils alcohol; pack it in a percolator; saturate the powder with alcohol so as to leave a stratum above. Cover percolator, and macerate the powder for 48 hours. Then proceed with the percolation, gradually adding alcohol until a sample of the percolate gives no more than a slight turbidity with water. Reduce the percolate to a thin syrupy consistency by distilling off the alcohol; then, with constant stirring, pour the syrupy extract into 200 mils distilled water which has been acidulated with 2 mils HCl, and then reduced to a temperature below 10° C. After subsidence is complete, decant the supernatant liquid, and wash the precipitate twice, by decantation, using fresh portions each time of 200 mils cold water. Dry the precipitate by spreading it in a thin layer on a strainer, and exposing it to the air in a cool place, protected from the light. If aggregated, when dry, pulverize in a mortar.

Note: Appearance ..... | Odor .....
Color ..... | Taste .....

Dose, 0.01 Gm. Take such a dose; report results: .....

.....

The two other official Resins are:

Resina Jalapæ. Dose, 0.125 Gm. Used in compound cathartic pill.
Resina Scammoniæ. Dose, 0.2 Gm. Used in compound colocynth extract.
These three resins have marked purgative properties.

MAGMÆ.

Magmas are thick, bulky suspensions in water of insoluble substances.

Prepare the official Magma Magnesiæ ("Milk of Magnesia") as follows: Smoothly mix 12.5 Gm. magnesium carbonate (in fine powder) with 50 mils distilled water. To this, with constant stirring, add a solution of 8 Gm. sodium hydroxide in 40 mils distilled water; agitate the mixture frequently for 15 minutes. Using 200 mils distilled water each time, wash the Magma by decantation, until 1 drop dil. H_2SO_4 will discharge the color of 3 drops phenolthalein T. S. when added to a 50-mil sample of the washing. Allow the precipitate to subside until it measures 100 mils; then decant the supernatant liquid, bottle, and tightly stopper.

Note: Appearance ..... | Odor .....
Color ..... | Taste .....

A small amount of any flavoring oil may be added if desired.
Milk of magnesia is sometimes used as an antacid. Dose, 10 mils.

The other official Magma is Magma Bismuthi ("Milk of Bismuth"), which is a convenient form for the administration of this substance. Dose, 4 mils.

PRESCRIPTIONS.

Compound the following prescriptions:

℞ Quininæ bisulphatis 1 | 25
Sacchari lactis, q. s.
Misce bene, et fac capsulas ad numero x.

℞ Strychninæ sulphatis | 060
Arseni trioxidi | 030
Massæ ferri carbonatis 2 | 5
Fiat massa et divide in pilulas xxx.

℞ Tincturæ nucis vomicæ 1 | 5
Acidi hydrochlor. dil. 8
Aquæ, q. s. ad 90
Misce.

℞ Liquoris potassii arsenitis | 75
Sodii bicarbonatis 1 | 50
Aquæ menth. piper. 90
Misce.

℞ Kalii iodidi 12
Syrupi sarsap. comp. 90
Misce.

℞ Hydrarg. chloridi mitis | 065
Pulveris ipecacuanhæ | 032
Sodii bicarbonatis | 65
Misce et in pulveres decem divide.

℞ Zinci oxidi 8
Pulveris amyli 8
Acidi salicylici | 65
Petrolati 15
Misce et fiat unguentum.

℞ Sacchari | 12
Olei menthæ piper. | 30
Alcoholis, q. s.
M. fiat solutionem et adde
Olei ricini 240

℞ Fluidext. ergotæ 20
Elixiris aromatici 40
Misce.

℞ Oleoresinæ filicis maris 4
Mucilaginis acaciæ 15
Syrupi zingiberis 8
Aquæ, q. s. ad 60
Misce.

UNKNOWNS.

Identification of Unknowns:

Sample	Appear.	Color	Odor	Taste	Chemical Tests	Identity
I						
II						
III						
IV						
V						
VI						
VII						
VIII						
IX						
X						
XI						
XII						
XIII						
XIV						
XV						
XVI						
XVII						
XVIII						
XIX						
XX						

EQUIVALENTS.

Tables of Metric Equivalents:

Milligram	Grains	Approx.	Milligram	Grains	Approx.	Milligram	Grains	Approx.
0.1	0.00154	1/648	1	0.01543	1/65	10	0.15432	2/13
0.2	0.00309	1/324	2	0.03086	1/33	20	0.30865	10/33
0.3	0.00463	1/216	3	0.04630	1/22	30	0.46297	5/11
0.4	0.00617	1/162	4	0.06173	1/16	40	0.61729	5/8
0.5	0.00772	1/130	5	0.07716	1/13	50	0.77162	23/30
0.6	0.00926	1/108	6	0.09259	1/11	60	0.92594	12/13
0.7	0.01080	1/93	7	0.10803	2/19	70	1.08026	1 1/12
0.8	0.01235	1/81	8	0.12346	1/8	80	1.23459	1 1/4
0.9	0.01389	1/72	9	0.13889	1/7	90	1.38891	1 3/8
1.0	0.01543	1/65	10	0.15432	2/13	100	1.54324	1 1/2

Milligram	Grains	Approx.	Gm.	Grains	Gm.	Avoirdupois oz. + grains	Apothecaries' oz. + grains
100	1.54324	1 1/2	1	15.4324	10	0 154.3	0 154.3
200	3.08647	3	2	30.8647	20	0 308.6	0 308.6
300	4.62971	4 3/5	3	46.2971	30	1 25.5	0 462.9
400	6.17294	6 1/6	4	61.7294	40	1 179.8	1 137.3
500	7.71618	7 3/4	5	77.1618	50	1 334.1	1 291.6
600	9.25941	9 1/4	6	92.5941	60	2 50.9	1 445.9
700	10.80265	10 4/5	7	108.0265	70	2 205.3	2 120.3
800	12.34589	12 1/3	8	123.4859	80	2 359.6	2 274.6
900	13.88912	13 5/6	9	138.8912	90	3 76.4	2 428.9
1000	15.43236	15 1/2	10	154.3236	100	3 230.7	3 103.2

Volumes:

Mils	Equivalent minims	Mils	Equivalent fl. oz.	minims	Mils	Equivalent pint	fl. oz.	minims
1	16.231	10	0	162.3	100	0	3	183.1
2	32.462	20	0	324.6	200	0	6	366.2
3	48.693	30	1	6.9	300	0	10	69.3
4	64.924	40	1	169.2	400	0	13	252.4
5	81.156	50	1	331.6	500	1	0	435.6
6	97.387	60	2	13.9	600	1	4	138.7
7	113.618	70	2	176.2	700	1	7	321.8
8	129.849	80	2	338.5	800	1	11	24.9
9	146.080	90	3	20.8	900	1	14	208.0
10	162.311	100	3	183.1	1000	2	1	391.1

Adapted from the United States Pharmacopeia, IXth ed.

PHARMACODYNAMICS.

(*Laboratory: Nine hours a week for one semester.*)

In this section of the Manual the student is expected to ascertain what physiological reactions are produced by some of the more important and powerful of the drugs he has been investigating heretofore in the other laboratory. He will work first with simpler forms, gradually progressing to relatively more important presentations. But at each stage his great purpose should be to discover exactly what departures from the normal do take place. He must be ever on his guard not to read into his observations any preconception, prejudice, or opinion. He must pay strict attention to the work in hand, lest some important manifestation escape his observation. He must consistently endeavor to perfect those cardinal faculties of careful observation, logical deduction, and careful notation, on which depends much of his future success.

Each student will be required to prepare himself concerning the technique of any given procedure before being assigned full responsibility. The best available book on this technique is "Jackson's Experimental Pharmacology"; an additional *vade mecum* is "Sollmann's Laboratory Guide." Leading texts in Pharmacology are Cushny and Sollmann. Reference periodicals are: *Journal of Pharmacology and Experimental Therapeutics, Journal of Laboratory Medicine, Journal of Biological Chemistry, Journal of Physiology, American Journal of the Medical Sciences, Journal of the American Medical Association.*

PART III.—PHARMACODYNAMICS.

ANÆSTHESIA.

ETHER, CHLOROFORM, NITROUS OXIDE, ETHYL CHLORIDE.

1. Take 3 frogs of equal size, weight, and condition. Count respirations, and note general reflex excitability. Place No. 1 in a flask fitted with stopper and thistle tube. Noting time, introduce 5 mils Ether. Observe and record symptoms.

Compare symptoms and times with effects produced with frog No. 2 when 5 mils Chloroform are used.

Compare symptoms and times on frog No. 3 when briefly subjected to the fumes of Ethyl Chloride.

2. Etherize lightly a large frog. Open its thorax just enough to connect heart with writing lever. Secure continuous tracings while frog is gradually killed with definite increments of ether per second. Note amount of Ether used, time required to produce a fatal effect, and graphic phenomena obtained. Tabulate your results.

3. Repeat Experiment No. 2, using Chloroform instead of Ether, having selected a frog of equal weight and condition. Tabulate your findings.

4. Secure a mammal (cat, dog, or rabbit). Gently soothe the animal, and observe its "normal" rate of pulse and respiration. Under the instructor's guidance, etherize the animal, carefully noting all phenomena educed. Let a student assistant fasten the animal to the operating board, and make suitable connections for registering pulse and respiration. Obtain graphs of the ether norms, and compare with the pre-ether findings of the same systems.

Proceed to bring about the death of the animal by definite increments of Ether per second. Carefully note all phenomena, both graphic and general, especially danger signals. What system weakens first under the influence of Ether?

As soon as death seems to have occurred, attempt resuscitation by: (*a*) dilating sharply the anal sphincter, using forceps; (*b*) compressing the thorax at the rate of 60 times a minute; (*c*) injecting adrenin solution (1 to 1000) into the jugular vein, the carotid artery, or through the thorax into the heart.

5. Repeat Experiment No. 4, using Chloroform instead of Ether.

6. Under the direct guidance of the instructor, carefully etherize a volunteer fellow-student.* Pay strict attention to your task, while other members of your section take careful notes of their findings as to pulse-rate, blood-pressure, respiration, and such other general phenomena as may be elicited.

Let the subject later describe his sensations, both while going under the influence of ether, and while coming out.

7. As assignments permit, make careful studies of respiration, pulse, blood-pressure, and other symptomatic phenomena, on various subjects undergoing anæsthetization in the operating room.

---

*Note: The student acting as anæsthetist should first have read very carefully the discussion on Anæsthesia in "Cushny's Pharmacology," pp. 211 to 218 inclusive.

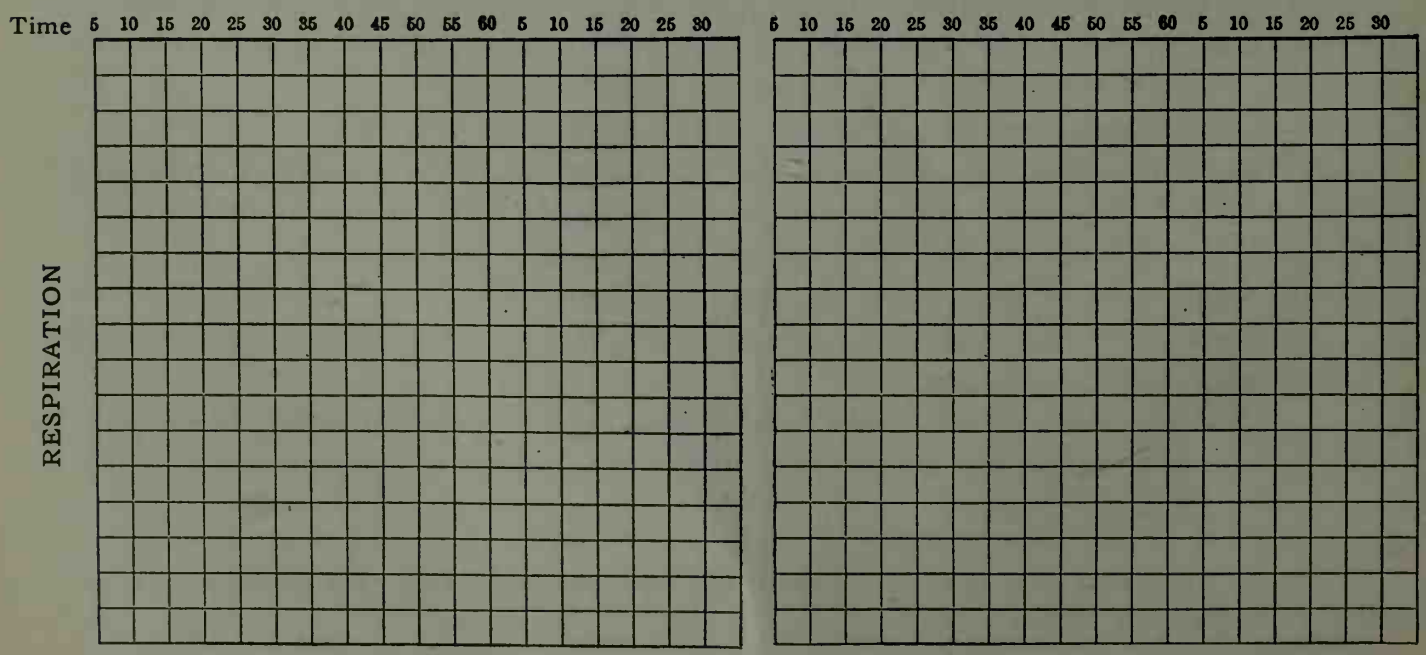
Experiment No. 1.

Date ..... Temperature ..... Humidity .....

Data for observation	Frog No. 1 Ether	Frog No. 2 Chloroform	Frog No. 3 Ethyl chloride	Frog No. 4 Nitrous oxide
Sex of frog				
Wt. of frog				
Condition				
Respiration				
Amt. of drug				
Time given				
1st symptoms				
2d symptoms				
After 1 minute				
Respirations				
2 min. symptoms				
2 min. respir.				
Complete anæs.				
Recovery time				
Remarks				

Experiments No. 2 and No. 3.

Ether frog: Chloroform frog:



Paste samples of Ether kymograph record here.

Paste samples of Chloroform kymograph record here.

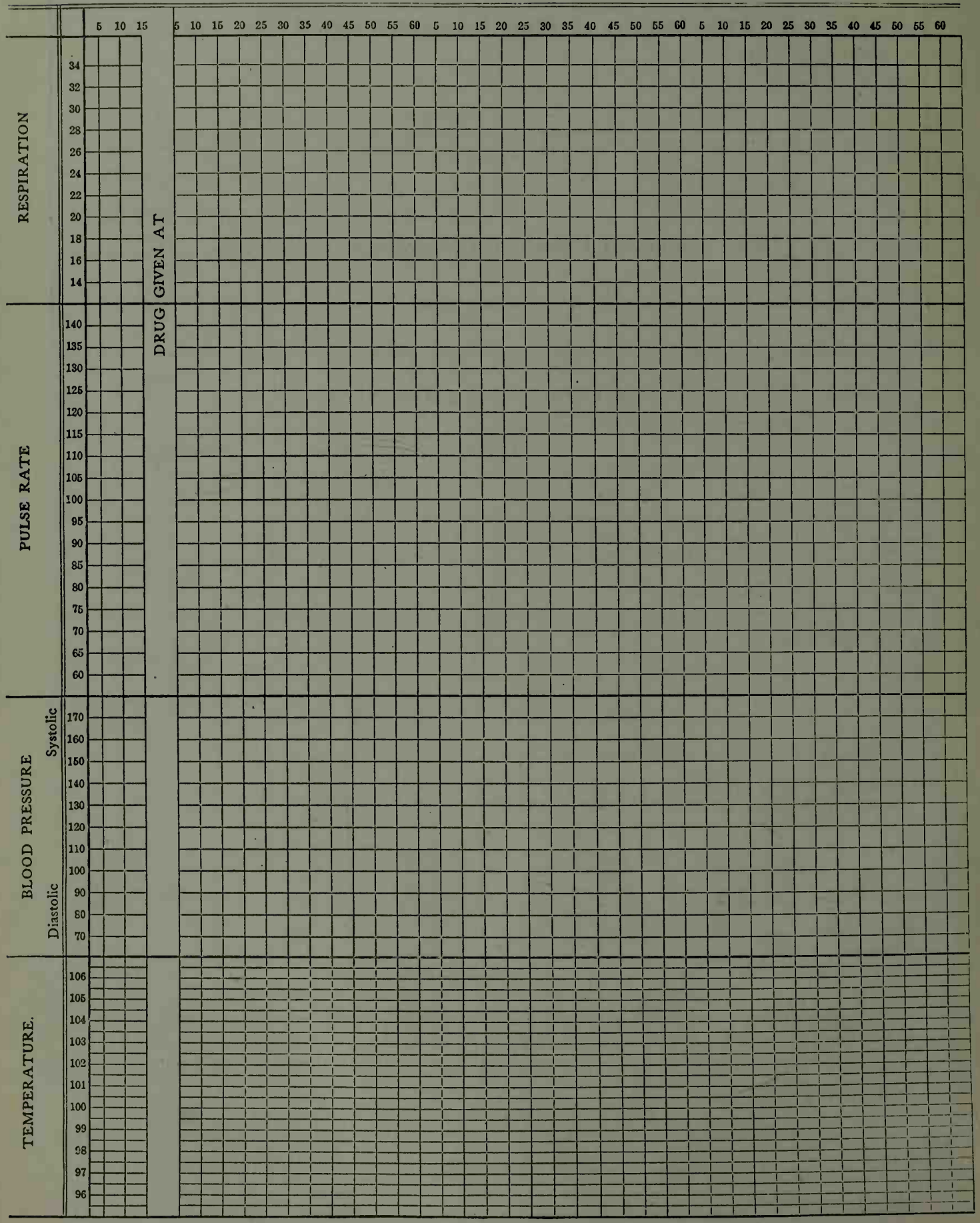
EXPERIMENTS No. 4 AND No. 5.

		Ether		Chloroform	
Animal	Sex				
Weight	Age				
Pulse	Respiration				
Kymograph norms					
Kymograph samples showing systemic failure and death					
Resuscitation Attempts: (*a*)					
(*b*)					
(*c*)					

Remarks: .....

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



Experiment No. 6.

Ether.

Observation on a fellow-student:

Observation	Normal	1st Stage	2d Stage	3d Stage	Recovery
Eye: Pupil					
Conjunctival reflex					
Naso-cardiac reflex					
Bucco-laryng. reflex					
Pharyngo-gastric reflex					
Position of tongue					
Salivary secretion					
Facies					
Resp. rate					
Resp. quality					
Heart rate					
Pulse quality					
Blood-pressure					
Condition of skin					
State of consciousness					
Muscle tonus					
Time					

Subject's report:

Experiment No. 7.

Ether.

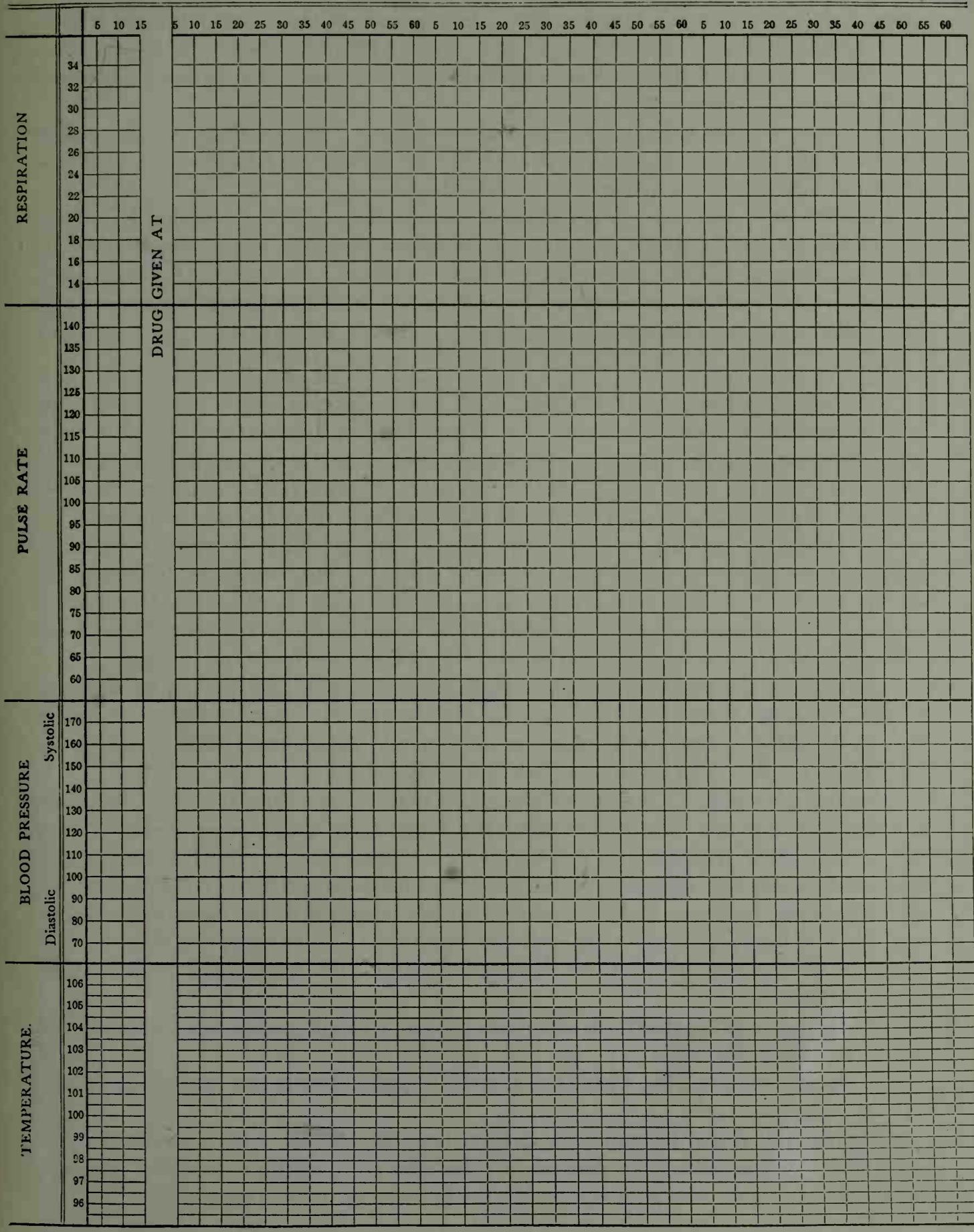
Observation of a patient in the operating room:

Observation	Normal	1st Stage	2d Stage	3d Stage	Recovery
Eye: Pupil					
Conjunctival reflex					
Naso-cardiac reflex					
Bucco-laryng. reflex					
Pharyngo-gastric reflex					
Position of tongue					
Salivary secretion					
Facies					
Resp. rate					
Resp. quality					
Heart rate					
Pulse quality					
Blood-pressure					
Condition of skin					
State of consciousness					
Muscle tonus					
Time					

Summary and remarks:

Patient's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Nature of illness .....
Day of illness .....
Physician ..... Service .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



MORPHINE.

1. Into the anterior lymph sac of a male frog inject 1 mil of a 4% solution Morphine Sulphate. Observe reactions for 2 hours in comparison with a normal frog of equal weight and with another frog of same weight which has had a like dose 2 hours previously. Note how these animals respond to sundry stimuli akin to that experienced in their normal environment.

2. Take 2 frogs of equal weight and condition. Compare their reactions when one has 1 mil of a 4% solution Morphine Sulphate injected into its stomach, while the other has a like dose injected into its anterior lymph sac.

3. Pith each brain of 2 frogs of equal weight and condition. By leg lymph sac administer to one 1 mil of a 4% solution Morphine Sulphate, to the other a like dose, but containing in addition 0.002 Gm. Atropine Sulphate. Arrange for heart tracings, and secure intermittent comparative records for the next two hours. Frogs must be kept moist, and at a constant cool temperature. What do your graphs seem to indicate?

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4. Take a cat, a rabbit, and a small dog. Obtain an average of 3 observations on each of heart-rate and respiration. To the rabbit give hypodermically of Morphine Sulphate 0.020 Gm. per kilogram body-weight; to the cat the same way, 0.050 Gm. per kilo; to the dog the same way, 0.020 Gm. per kilo. Carefully observe the comparative sequence of phenomena elicited by Morphine Sulphate on these types of mammals.

5. When the animals in Experiment No. 4 show evidences of narcotism, lightly etherize them, place on animal-board, connect with recording apparatus. Remove the ether. Continue records until death ensues, administering more of the Morphine if necessary. (Sollmann gives the minimal fatal dose (M. F. D.) of Morphine as follows: dog, 0.4 Gm. x kg.; cat, 0.04 to 0.08 Gm. x kg.; rabbit, 0.3 Gm. x kg.)

6. Select 3 fasting rabbits of like weight and condition. Administer by stomach, to one, Morphine Sulphate 0.020 Gm. x kg.; to the second, Tincture Opium, 2 mils x kg.; to the third, Morphine Sulphate, 0.020 Gm. and Atropine Sulphate 0.002 Gm. x kg. Compare reactions throughout laboratory period.

7. Let a member of the class volunteer to take 0.020 Gm. Morphine Sulphate. Let him be seated in a comfortable position, in a steamer chair for example. Secure his normal pulse, respiration, blood-pressure and temperature. With æsthesiometer test his forearm and forehead for tactile discrimination. Test his reaction time for sight, hearing, feeling. Make speed tests of his mental activity, using the antonym test, the test for imagery, and the multiplication test. Let him take the drug in solution. Take systemic observations every 10 minutes, and mental and æsthesic tests every half hour.

8. In the hospital, study various cases to whom Morphine has been administered by the attending physician.

9. In the psychopathic ward, study cases under treatment for the relief or cure of morphinism.

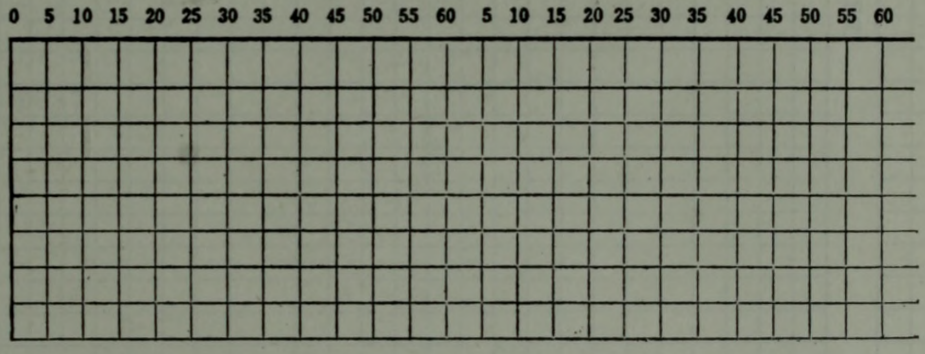
10. Consult recent literature for at least four discussions of the pharmacology of Morphine. Write up a brief *résumé* of your laboratory findings, checking the same with citations from your readings, either confirmative or otherwise.

Experiments with Morphine.

Experiment No. 1.

Observation	Normal frog			Narcotized frog 1			Narcotized frog 2		
	30 min.	60 min.	90 min.	30 min.	60 min.	90 min.	30 min.	60 min.	90 min.
Excitability									
Climbing incline									
Swimming									
Escaping from under submerged beaker									
Cutan. sensibility									
Clasping female									

Respiration graphs:



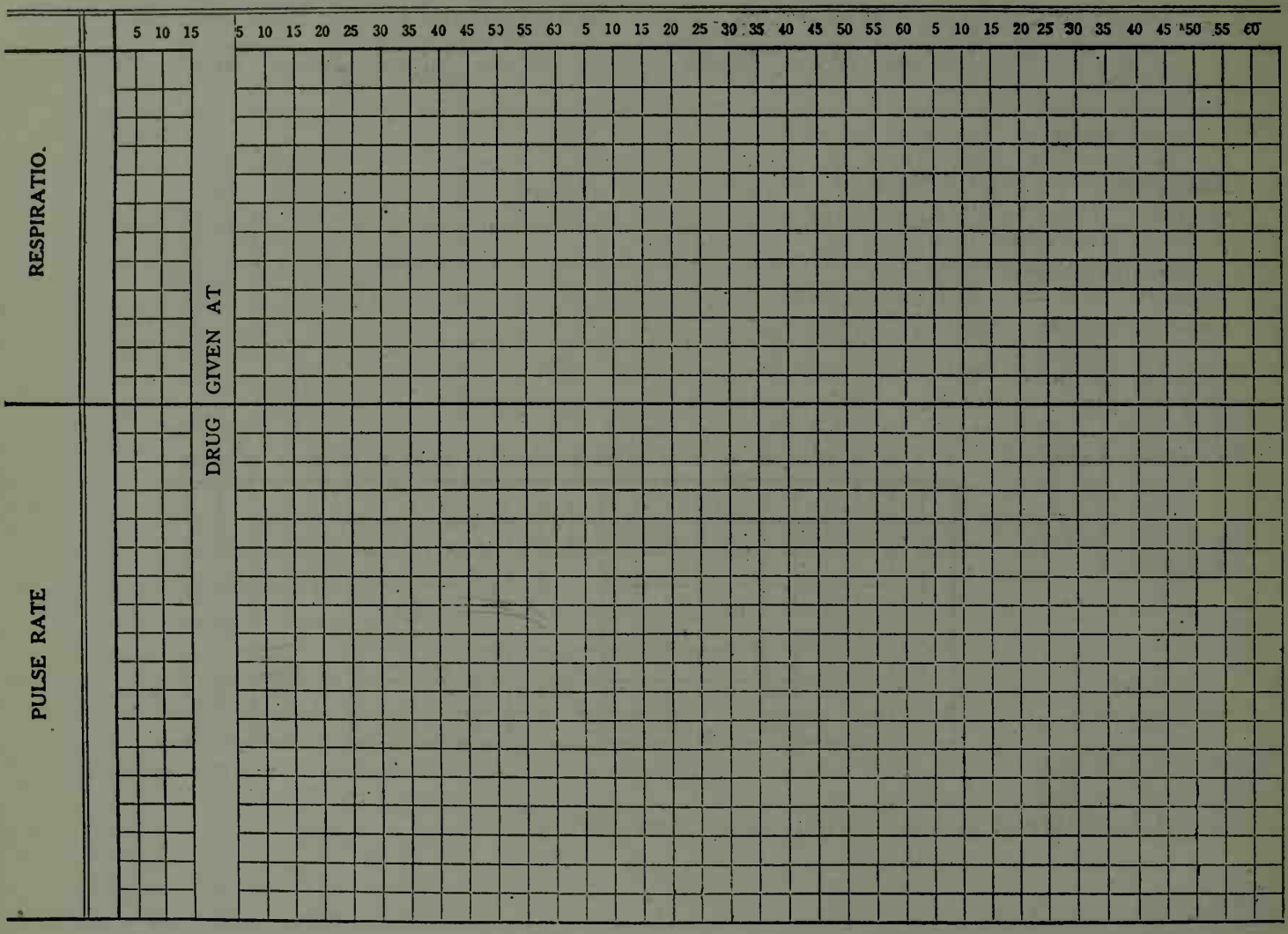
Experiment No. 2. Briefly state your findings.

Experiment No. 3. Paste in samples of your Kymograph records.

What are your deductions?

Experiments No. 4 and 5.

Graphs of respiration and pulse*:



Observation	Rabbit	Time	Cat	Time	Dog	Time
Disposition						
Alterations of D.						
Restlessness						
Excitement						
Frenzy						
Salivation						
Nausea						
Vomiting						
Defecation						
Drowsiness						
Stupor						

* For uniformity use red ink for cat, blue for dog, and green for rabbit.

EXPERIMENTS No. 4 AND 5 (*continued.*)

Pupil changes	Elapsed Time in Minutes										
	10	20	30	40	50	60	10	20	30	40	50
Rabbit											
Cat											
Dog											

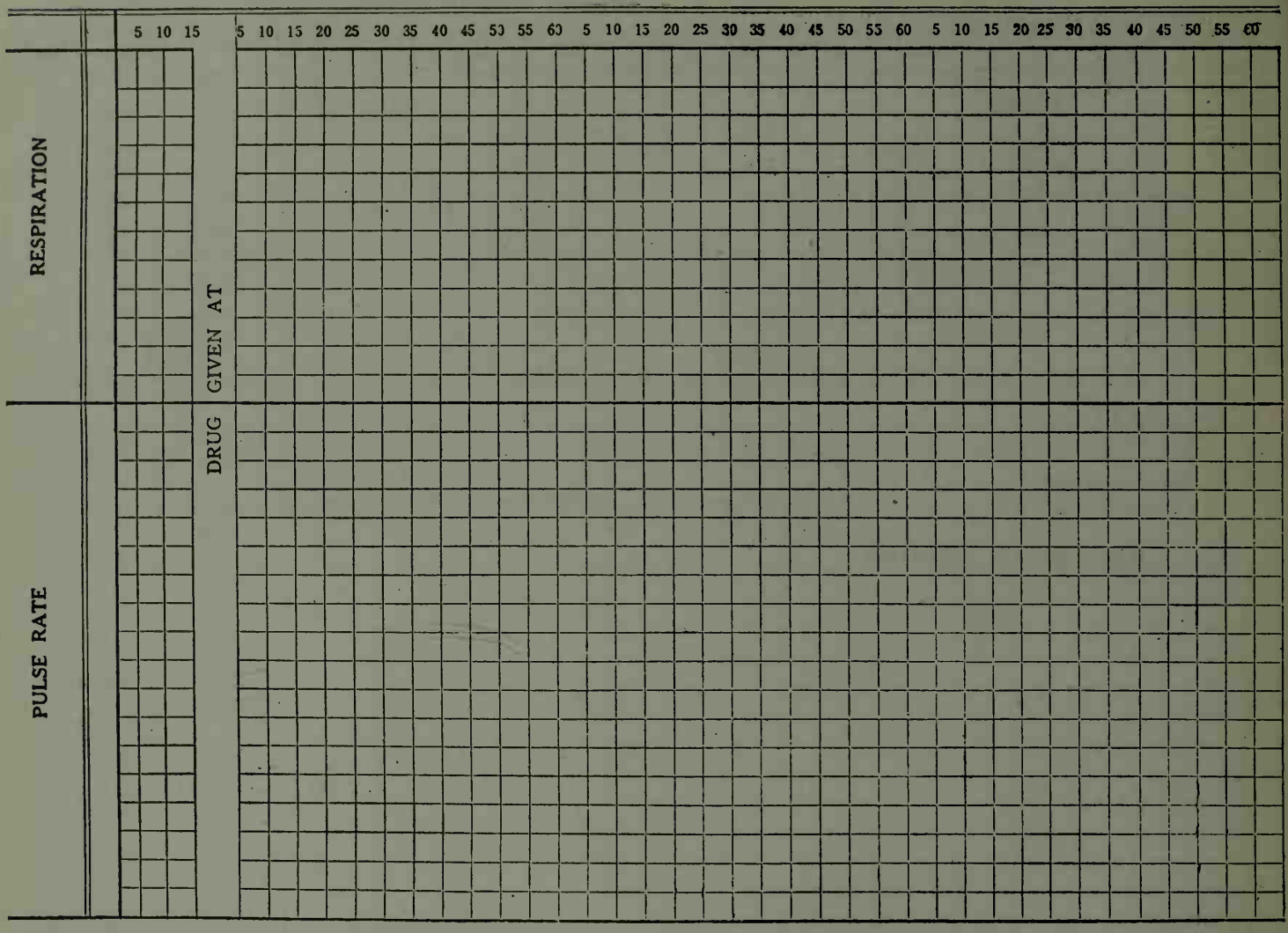
	Rabbit	Cat	Dog
Cause of death			
Time elapsed			

Kymograph records:

EXPERIMENT No. 6.

	Rabbit No. 1 Morphine			Rabbit No. 2 Tincture Opium			Rabbit No. 3 Morph. + Atrop.		
Mental variations									
Excitement									
Stupor									
Lethargy									
Pupil changes									

EXPERIMENT No. 6 (*continued*).

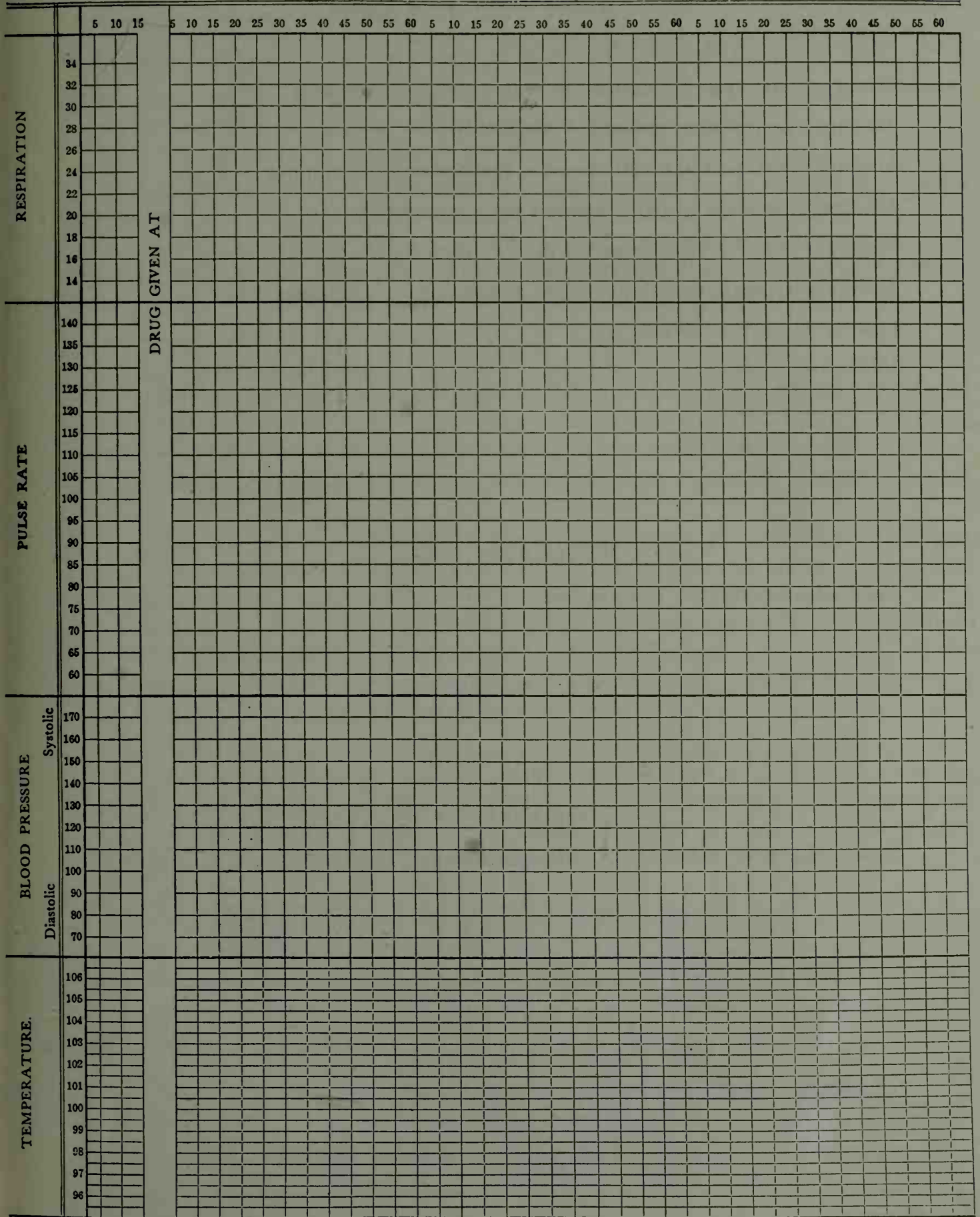


EXPERIMENT No. 7.

	Normal	After 30 ′	After 60 ′	After 90 ′	After 2 hours
Æsthesia					
Reaction time Sight					
Hearing					
Touch					
Mental agility Antonyms					
Imagery					
Multiplication					

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



Experiment No. 8.

Sex of patient,.....; approximate age,.....; illness, ...
date of illness,.....; present condition of patient,.....
why drug was ordered at this time,.....

Maximal variation in respiration reached in minutes

Maximal variation in pulse-rate reached in minutes

Maximal variation in blood-pressure reached in minutes

Maximal variation in pupil reached in minutes

Maximal sedative effect reached in minutes

Maximal hypnotic or sedative effect reached in minutes

Quality of sedative effect,.....

Remarks:.....

.....

.....

.....

Experiment No. 9.

Concisely report your observations:

.....

.....

.....

.....

Experiment No. 10.

Summarize your conclusions, with citations:

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STRYCHNINE.

1. Take 3 frogs of equal weight and condition. Pith the brain of one, and the cord of the other; leave the third normal. Noting exact time of administration, inject into the lymph sac of each frog 0.25 mil of 0.01% solution Strychnine Sulphate (=0.025 mg.). Make careful comparative observations of results.

2. Inserting one blade of the scissors transversely in a frog's mouth back to the angle of the jaws, amputate the cranium. Plug the aortæ to stop hemorrhage. To the exposed cervical cord apply a pledget of cotton moistened with 0.1% solution Strychnine Sulphate. Test reflexes by pinching first the hind-legs, then the fore-legs. Apply minimal break shocks to different cutaneous areas. Explain results.

3. Prepare an anæsthetized mammal (rabbit, cat, or dog) for timed circulatory and respiratory registrations. Obtain ether norms. Intramuscularly administer Strychnine Sulphate 0.7 mg. x kg. Secure continuous tracings throughout, noting extent and character of all variations. Attempt an explanation of each variation. What tentative assumptions might this experiment by itself seem to warrant?

4. Have a fellow-student dispose himself comfortably in a semi-recumbent posture. After 5 minutes secure an average of 3 observations on his several systems. Make the following tests: æsthesia of flexor surface of forearm, color vision, range and acuity of vision, weights discrimination, reaction time, mental facility in multiplication. Administer intramuscularly 0.003 Gm. Strychnine Sulphate. Plot your curves, and repeat the above tests every 45 minutes. Compare results with three others. May any divergencies be explained by temperament or physique?

5. As hospital assignments permit, make careful studies of patients to whom the attending physician has prescribed Strychnine, noting particularly how the several systems seem to respond. Is the reaction observed similar to the accepted laboratory findings? If not, endeavor to ascertain why.

6. Consult recent literature for at least three articles dealing with Strychnine activity. Write a brief *résumé* of your findings, and check them with citations from your readings.

Experiment No. 1.

0.25 mil 0.01% sol. Strychnine Sulphate:

	Frog A	Frog B Brain pithed	Frog C Cord pithed
Drug given, when?			
Increased reflexes			
Convulsions (time)			
Character			
Duration			
Termination			
Minimal stimulus			
Stimulus optional			
Location			
Quality			

What deductions may be tentatively drawn? .....

.....

.....

Experiment No. 2.

Explain briefly your findings: .....

.....

.....

Experiment No. 3.

Kymograph records of Strychnine action: .....

EXPERIMENT No. 3 (*continued*).

Explain variations that developed. What assumptions seem warranted?

.....

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EXPERIMENT No. 4.

Strychnine Sulphate, 0.003 Gm. to a student:

Observations	Subject No. 1			Subject No. 2			Subject No. 3			Subject No. 4		
	Norm.	45m	90m	Norm.	45m	90m	Norm.	45m	90m	Norm.	45m	90m
Æsthesia												
Color vision												
Range of vision												
Acuity of vision												
Weights discrimination												
Reaction time												
Sight												
Sound												
Touch												
Multiplying time												
Pulse rate												
Respiration												
Blood-pressure												

Remarks:

Subject's initials or No. ..... Date .....

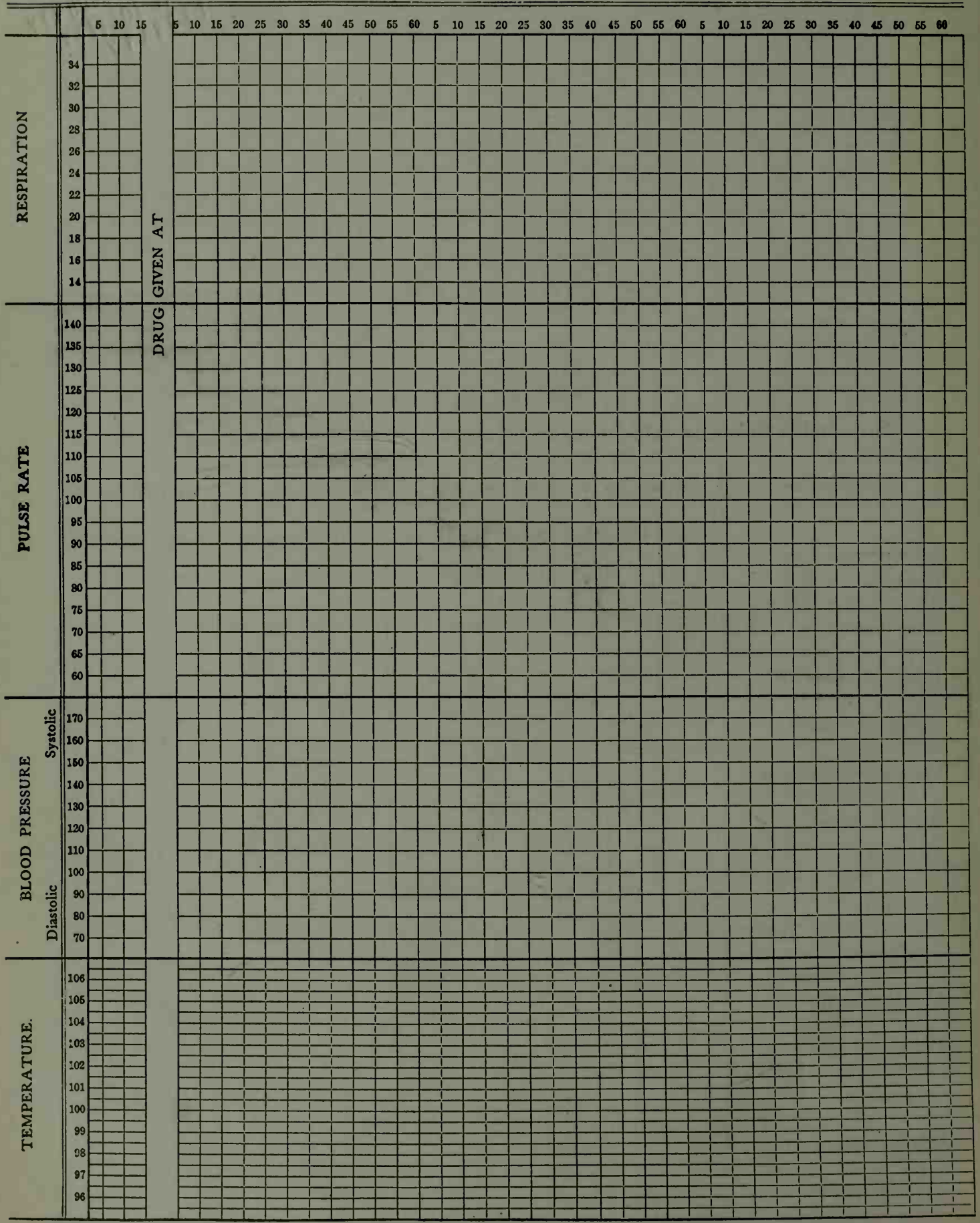
Age .....Sex .....Height .....Weight ..... Medicine .....

Condition ..... Dose .....

Thermometer ..... How administered .....

Barometer ..... Remarks .....

Relative humidity ..... Reporter .....



Experiment No. 5.

Report:

Experiment No. 6.

Report:

ATROPINE.

1. To a frog administer by anterior lymph sac 0.010 Gm. Atropine Sulphate. Observe respiration and reflexes in comparison with a frog of equal weight and condition similarly drugged one hour previously.

2. Expose the heart of a pithed frog. Secure a normal cardiac tracing, one as affected by weak stimulation of the vagus, and another as affected by stimulation of the sinus venosus. Apply Atropine Sulphate solution, 0.1%, continuing the record. After a few minutes, apply the weak current as before, noting any variation from the preceding graph. How may these variations be explained?

3. Take two cats of equal weight and condition. Obtain their heart-rates and respirations, and note the size and condition of their pupils. To each administer 0.04 mg. x kg. Atropine Sulphate, giving it by stomach to one, and hypodermically to the other. Make careful comparative observations for 2 to 3 hours.

4. Etherize a cat, arrange connections for registering circulatory and respiratory phenomena. Secure ether norms, and records resulting from stimulating vagus with minimal induced electric currents. Into jugular vein slowly inject 0.05 mg. x kg. Atropine Sulphate, making continuous tracings in the meanwhile. When a pronounced effect is apparent, again stimulate the vagi with the same strength current as before. What results?

Continue injection of Atropine Solution until death ensues, noting all important phenomena.

5. On two students of similar weight and condition secure normals of pulse-rate, respiration, blood-pressure, temperature, and pupil. To one administer 0.8 mg. Atropine Sulphate in solution by mouth; to the other, 1 mil Tincture Belladonna (=0.3 mg. total alkaloids). Make comparative observations of all systems for the next two hours.

6. Take 2 rabbits of equal weight and condition. Hypodermically administer to one 2 mg. x kg. Atropine Sulphate, to the other give 1.5 mg. x kg. Hyoscine (Scopolamine) Hydrobromide. Make critical comparison for the next 2 hours.

7. Try out a similar experiment on 2 students of approximate weight and condition, using 0.5 mg. (per total weight) Atropine Sulphate, and 0.8 mg. Hyoscine Hydrobromide.

8. In the hospital assignment endeavor to ascertain any reactions, in various illnesses, reasonably due to the administration of Atropine.

9. In a brief *resumé* summarize the evidences you have observed concerning the pharmacodynamics of Atropine. Cite from recent literature at least four studies of this drug; these may either seem to confirm or question your findings.

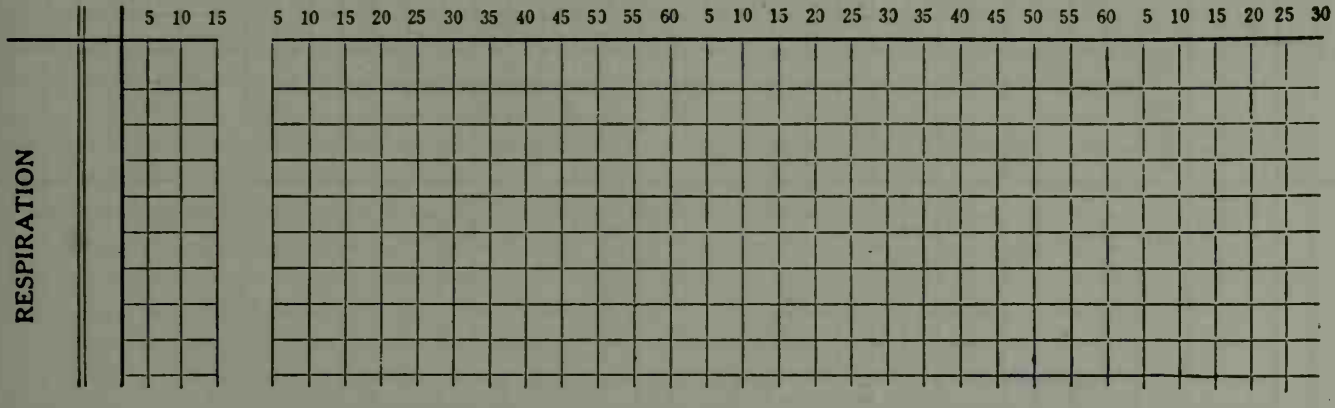
Experiment No. 1.

Atropine experiments.

	Frog No. 1			Frog No. 2		
	Now	30 min.	60 min.	Now	30 min.	60 min.
Excitability						
Cutan. sensibility						

Examine both these frogs daily for one week.

Respiration curve followed during laboratory period.



Experiment No. 2.

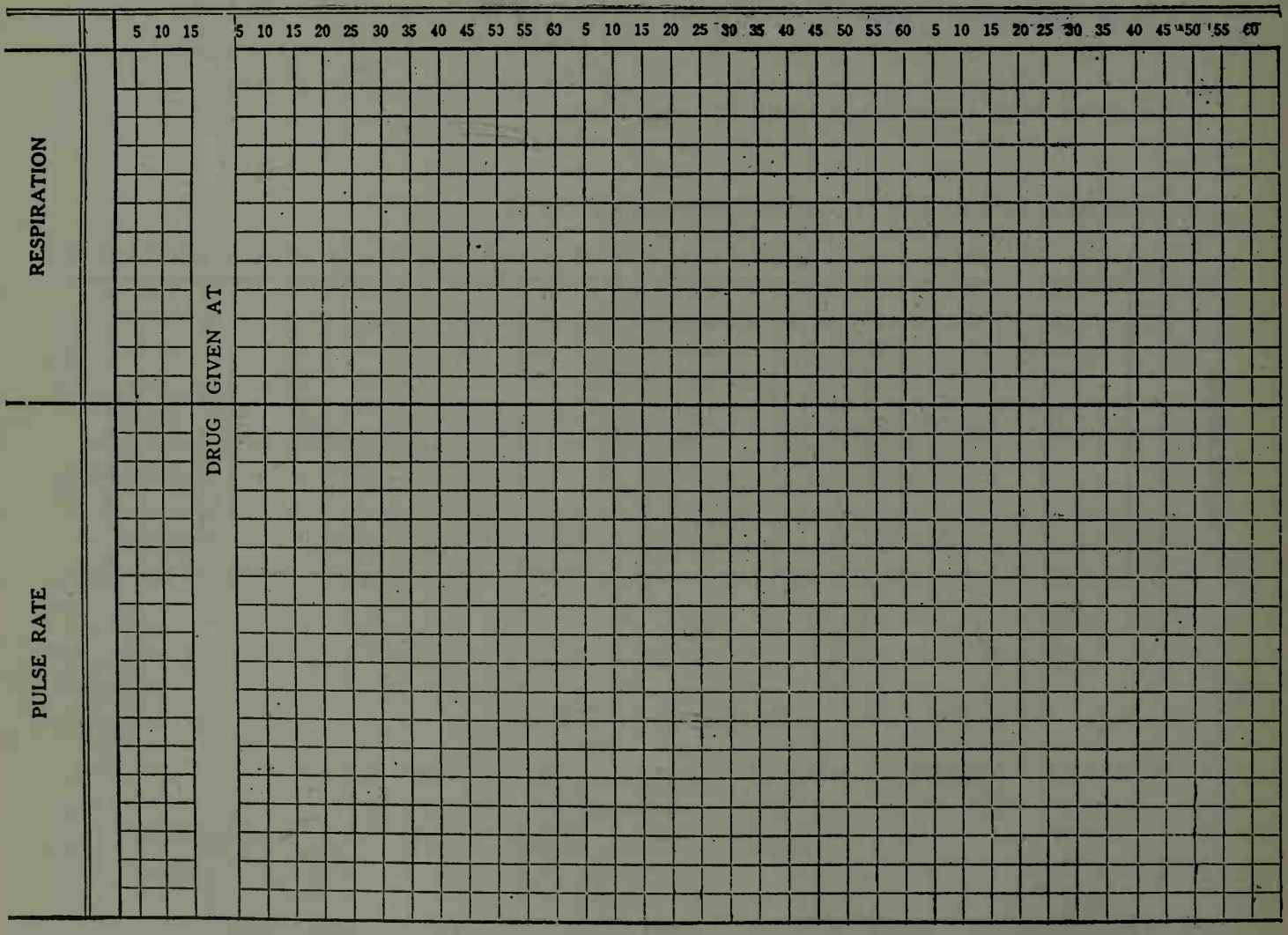
Kymograph records:

	"Normal"	Vagus Stim.	Crescent Stim.
Pithed frog			
Atropine frog			

Experiment No. 3.

Atropine Sulphate, 0.04 mg. x kg. to cats:

Pupil changes	N.	15′	30′	45′	60′	10′	20′	30′	40′	50′	60′
Cat No. 1											
Cat No. 2											



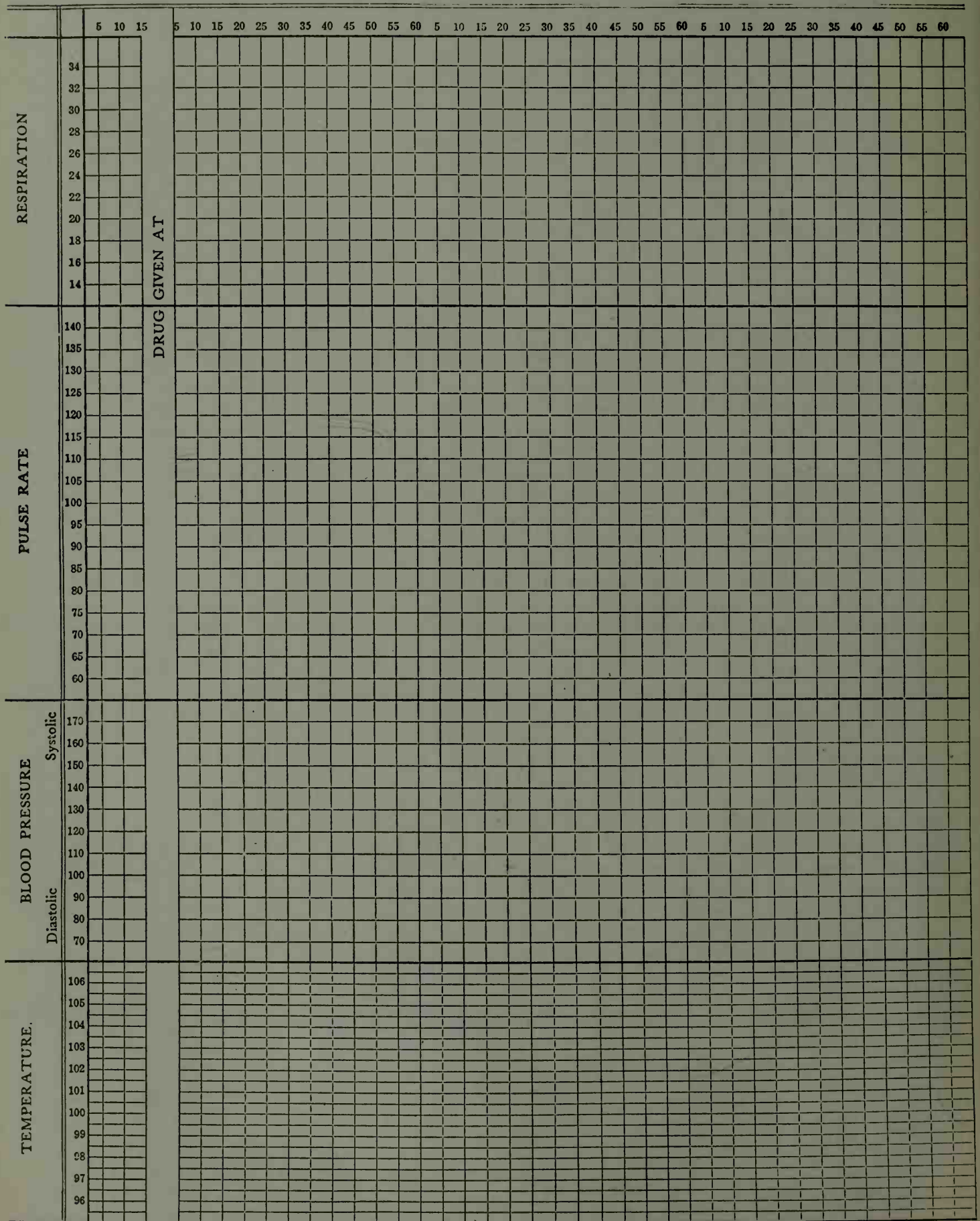
Experiment No. 4.

Graphs:

Experiment No. 5.

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



EXPERIMENT No. 5 (*continued*).

What subjective symptoms are elicited?

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EXPERIMENT No. 6.

Hyoscine and Atropine action compared. Rabbits:

	N.	15′		30′		45′		60′		15′		30′		45′	
		H.	A.	H.	A.	H.	A.	H.	A.	H.	A	H.	A.	H.	A.
Respiration															
Heart-rate															
Mental state															
Pupil															
Reflex excitability Light															
Sound															
Air currents															
Induced shocks (standard)															

Experiment No. 7.

Hyoscine and Atropine action compared. Man:

	N.	15′		30′		45′		60′		15′		30′		45′	
		H.	A.	H.	A.	H.	A.	H.	A.	H.	A.	H.	A.	H.	A.
Respiration															
Pulse-rate															
Blood-pressure															
Temperature															
Mental state															
Pupil															
Tact. discrimination (forearm)															
Light reflex															
Sound reflex (Galton whis.)															
Air currents															
Induced shocks (constant)															
Mucosa															

Experiment No. 8.

Briefly summarize your findings at the hospital:

Experiment No. 9.

Summary of evidences from laboratory and literature:

PILOCARPINE AND PHYSOSTIGMINE.

1. Obtain a heart tracing from a frog with pithed brain. Apply 2 drops 0.6% solution Pilocarpine to the frog's heart, carefully noting any variations in the record. Wash the heart with normal saline (=0.65% for frogs), and then apply 2 drops 0.1% solution Atropine Sulphate. When definite effect is produced, wash again with normal saline; then study effect of alternation of the drugs, noting relative amounts of each required to produce definite results. Allow at least 30 seconds between successive applications.

2. Repeat Experiment No. 1, using 0.03% Physostigmine solution in place of the Pilocarpine.

3. Having obtained a heart tracing of a frog with pithed brain, inject into the thigh lymph sac 0.5 mil of a 0.6% solution Pilocarpine, and note what effect this may have on the tracing. See also if 1 drop of a 0.01% solution Atropine Sulphate will produce a distinct variation in the curve.

4. Repeat Experiment No. 3, using 0.03% solution Physostigmine.

5. Into thigh lymph sacs of two frogs of equal weight and condition inject 0.3 mil of a 0.01% solution Atropine Sulphate. Obtain continuous tracings, and when the Atropine action is marked, see how much Pilocarpine solution, 0.6%, applied locally at the rate of 2 drops every 30 seconds, is necessary to overcome the Atropine action in one frog, and how much Physostigmine in the same ratio of increments is necessary with the other frog.

6. Into one eye of a rabbit instill 1 drop 0.6% solution Pilocarpine; repeat with another rabbit, using 0.03% solution Physostigmine. Study the effect for one-half hour; then instill in the treated eye of each rabbit 1 drop of 0.01% Atropine solution. Seek an explanation.

7. Etherize a rabbit, and secure normal respiratory and circulatory tracings. Rapidly dissect the skin from the abdomen, and notice coils of intestine showing through the thin muscle walls. With etherization light, administer by vein 3 mils x kg. of a 1 to 1000 solution Pilocarpine, obtaining meanwhile a continuous record, and noting all phenomena. When reaction becomes pronounced, administer by vein 1.5 mg. x kg. Atropine in solution.

Later, cause death with 10% Pilocarpine, taking continuous record.

8. Repeat Experiment No. 8, using Physostigmine, 1 mg. x kg.

9. Let some student, who is normally somewhat constipated, take 1 mg. Physostigmine (Eserine) Salicylate. Let his associates take the customary systemic records.

10. In the ophthalmology clinic, study the use there of both Pilocarpine and Physostigmine.

11. In the hospital assignment, an opportunity may arise, in connection with post-operative observations in abdominal surgery, to study the action of Physostigmine; and in the medical ward to study the action of Pilocarpine in the treatment of uræmia.

12. Tabulate your findings concerning these two drugs. Extend your tabulations by observations drawn from recent literature.

Experiment No. 1.

Kymograph records. Pilocarpine, 0.6%; Atropine, 0.1%:

Normal	Pilocarp. 2 gtt.	NaCl	Atropine, 2 gtt.
"Normal," No. 2	2nd Piloc. gtt.	NaCl, No. 2	2nd Atrop. gtt.
"Normal," No. 3	3rd Piloc. gtt.	NaCl, No. 3	3rd Atrop. gtt.

Experiment No. 2.

Kymograph records. Physostigmine, 0.03%; Atropine, 0.1%:

Normal	Physost. 2 gtt.	NaCl	Atropine, 2 gtt.
"Normal," No. 2	2nd Physost. gtt.	2nd NaCl	2nd Atrop. gtt.
"Normal," No. 3	3rd Physost. gtt.	3rd NaCl	3rd Atrop. gtt.

Experiment No. 3.

Normal	Pilocarpine, 0.6%	Atropine, 0.01%

Experiment No. 4.

Kymograph records:

Normal	Physostigmine, 0.03%	Atropine, 0.01%

Experiment No. 5.

Atropine, 0.3 mg.	Pilocarpine, mg.	Atropine, 0.3 mg.	Physostig., mg.

Experiment No. 6.

	N	10′	20′	30′	Atropine	5′	10′	15′	20′
Pilocarpine									
Physostigmine									

Experiment No. 7.

	Respiration	Circulation
Normal		
Pilocarpine		
Atropine		
F. D. Pilocarpine		

Experiment No. 8.

Kymograph records:

	Respiration	Circulation
Normal		
Physostigmine		
Atropine		
F. D. Physostig.		

Experiment No. 9.

Report of internal symptoms experienced by subject: .....

.....

.....

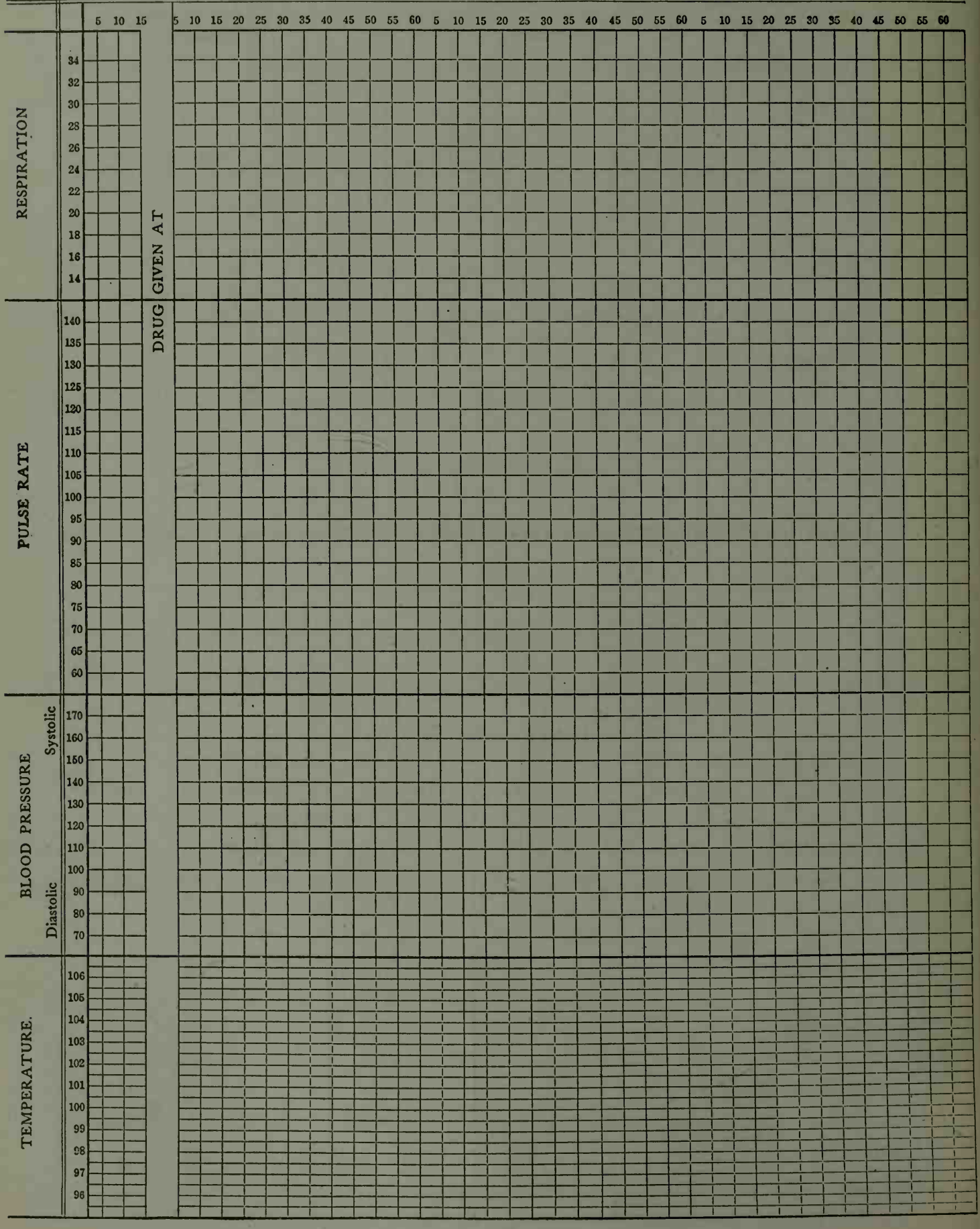
.....

Experiment No. 10.

	Why used	Amount	Interval	Result	Findings
Pilocarpine					
2nd Case					
3rd Case					
Physostigmine					
2nd Case					
3rd Case					

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



Experiment No. 11.

	Why ordered	Resp.	Pulse	B. P.	Interval	Result	Resp.	Pulse	B. P.	Pupil
Pilocarpine										
2nd Case										
3rd Case										
Physostigmine										
2nd Case										
3rd Case										

Experiment No. 12.

Your experience, checked by references:

	Pulse	Resp.	B.P.	Eye	Saliv. gland	Other glands	Alim. tract	Bronchi	Addenda
Pilocarpine									
Ref. 1=									
Ref. 2=									
Ref. 3=									
Physostigmine									
Ref. 1=									
Ref. 2=									
Ref. 3=									

CAFFEINE.

1. Carefully make 2 muscle preparations, place them in glass capsules, connect with weighted muscle levers, and obtain contraction records using minimum break shocks only. Fill one capsule with Locke's solution, and the other capsule with Locke's solution containing 0.1% Caffeine. Obtain comparative contraction records every half minute.

2. To a cat administer 0.120 Gm. Caffeine. Take observations of pulse, respiration, and nervous state.

3. Etherize a large female cat or rabbit. Connect up recording apparatus, and obtain normals of respiration and circulation. Into the bladder introduce a suitable catheter; distend bladder gently with normal saline; then arrange for collecting urine in centesimal metric graduate. At the rate of ½ mil every 15 seconds, run into the jugular vein Caffeine—2% in Locke's solution (kept at 38° C.). Take continuous record, and note amount of urine passed every 20 minutes. Note any symptoms that may develop.

Check this experiment by repeating it on another cat of equal weight and condition, but omitting the Caffeine.

4. With a subject in a comfortable position, obtain his normal pulse, respiration, blood-pressure, and temperature. With æsthesiometer test his forearm for tactile discrimination. Test his reaction time for sight, hearing, and feeling. Make speed tests of his mental activity, using the antonym test, the imagery and multiplication tests. Administer 2 mils of a 10% solution Caffeine Citrate subcutaneously into loose cellular tissue. Make usual graphs. Take intellection tests every 45 minutes. Measure urine excreted every hour for 8 hours.

5. Make comparative observations on three similar subjects, to one of whom is administered 0.3 Gm. Caffeine, to the second is given a cup of hot coffee, to the third is given a cup of cold coffee of the same brew. Note the several systems, including the excretory.

6. In the hospital assignment, especially study the effect on the heart of Caffeine, wherever administered.

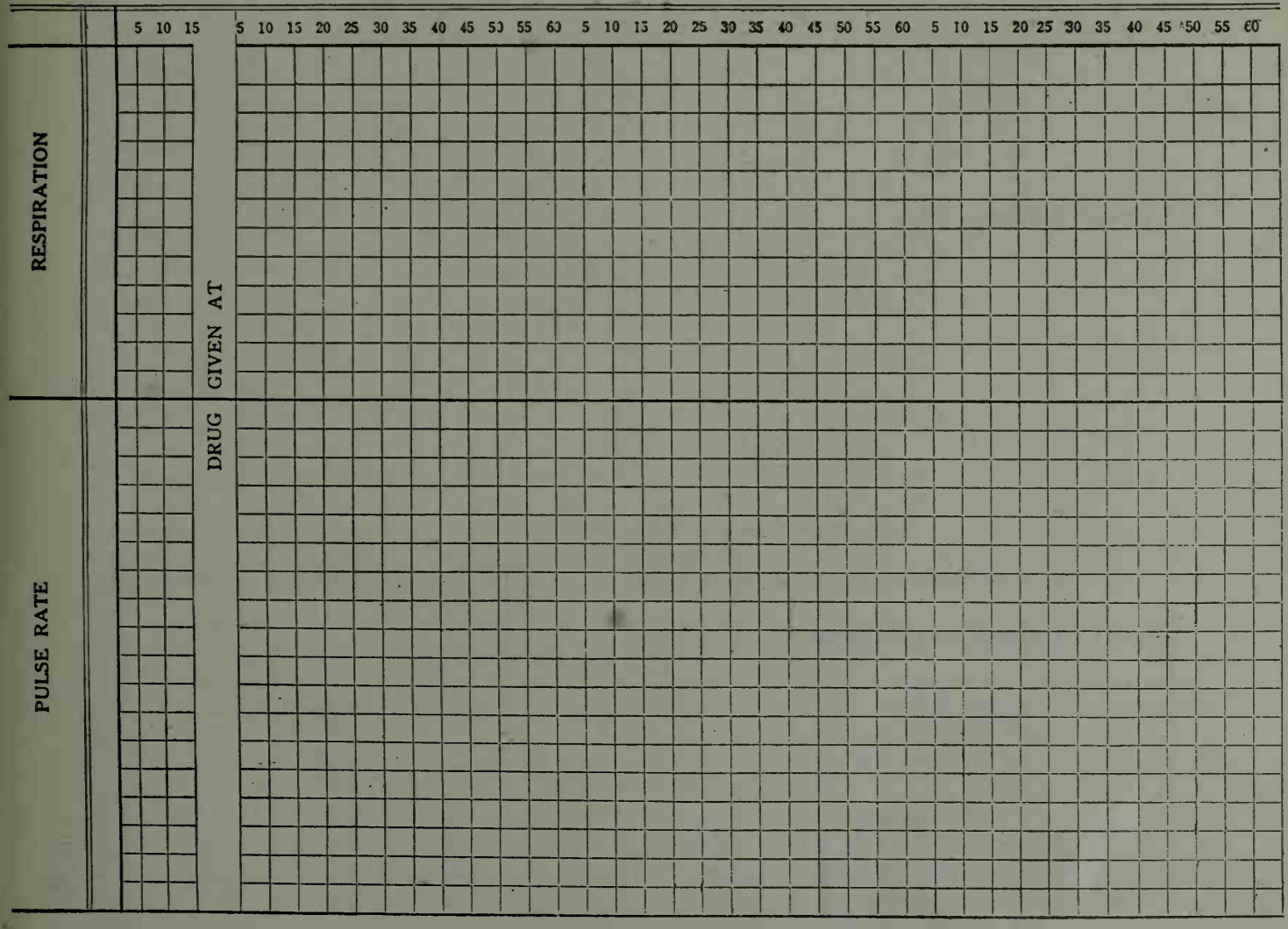
7. From all your observations, and from your readings, write a summary of the leading effects produced by Caffeine.

Experiment No. 1.

Kymograph records.

	Preparation No. 1	Preparation No. 2
Normal response		
Solution response		
Reaction A		
Reaction B		
Reaction C		

Experiment No. 2.



	Norm.	10′	20′	30′	40′	50′	60′	10′	20′	30′	40′	50′
Nervous state												

Experiment No. 3.

	20′	40′	60′	20′	40′	60′	20′	40′	60′
Amt. of urine passed									
Respiration									
Pulse rate									

Definite symptoms.

Explanation.

Kymograph records:

Report of check experiment:.....

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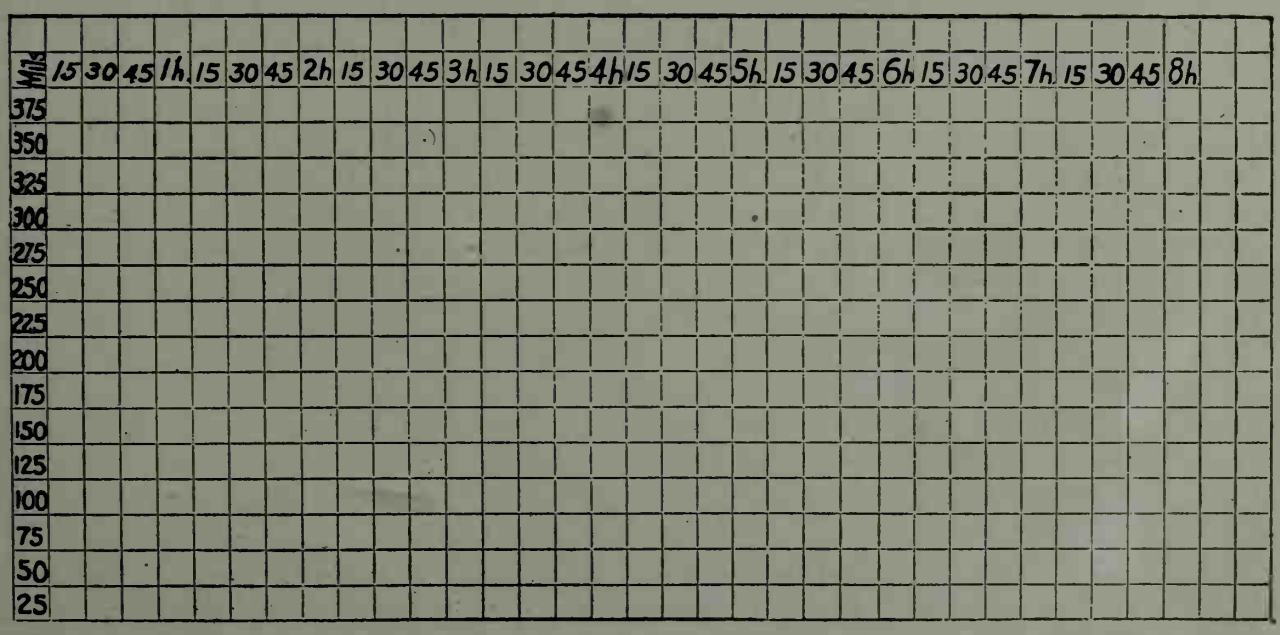
Experiment No. 4.

Caffeine, 0.2 Gm. to a student:

	1			2			3			4		
Observation	N.	45′	90′	N.	45′	90′	N.	45′	90′	N.	45′	90′
Æsthesia												
Reaction: Sight												
Sound												
Touch												
Antonym test												
Imagery test												
Multiplication test												
Pulse-rate												
Respiration												
Blood-pressure												

Graph of kidney activity:



Subject's initials or No. ..... Date .....

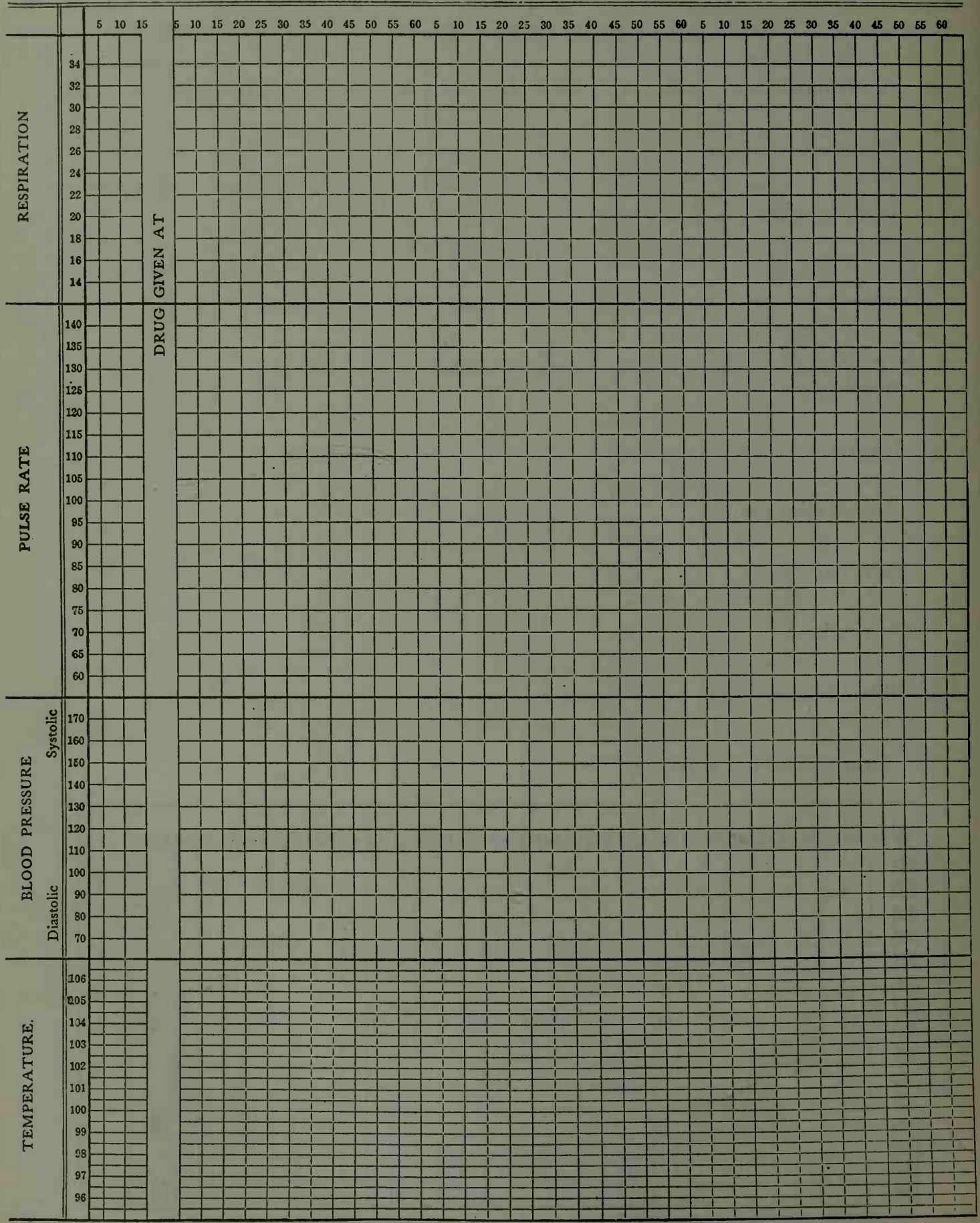
Age .....Sex .....Height .....Weight ..... Medicine .....

Condition ..... Dose .....

Thermometer ..... How administered .....

Barometer ..... Remarks .....

Relative humidity ..... Reporter .....



Experiment No. 5.

	10′	20′	30′	45′	1 h.	15′	30′	45′	2 h.	3 h.	4 h.	5 h.	6 h.
Respiration													
Pulse-rate													
Blood-pressure													
Temp. (axill.)													
Strength, r. h.													
Urine excreted													

Experiment No. 6.

			Respiration					Pulse-rate					Blood-pressure				
Case	Illness	Status	"N"	15′	30′	45′	60′	"N"	15′	30′	45′	60′	"N"	15′	30′	45′	60′
I																	
II																	
III																	
IV																	
V																	

Experiment No. 7.

Summary and evidence:.....

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CHLORAL HYDRATE.

1. Select 3 frogs of equal weight and condition. By anterior lymph sac administer the following amounts of a 2% solution of Chloral Hydrate: 0.5 mil to frog No. 1, 1 mil to frog No. 2, 1.5 mil to frog No. 3. Keep the frogs moist, and record all variations observed, with their comparative times. Note symptoms the next day.

2. Pith a frog of fair size. Administer by thigh lymph sac 0.5 mil 10% solution Chloral Hydrate. Expose heart, connect with recording lever, and take continuous record on a slow drum, keeping heart moist with normal saline. Once every 5 minutes record a single contraction wave on a fast drum. Make comparative studies of your findings.

3. Take two cats of equal weight and condition. Secure normals of pulse and respiration. To one administer by mouth 3.5 mils 10% sol. Chloral Hydrate; to the other give the same dose plus 0.12 Gm. Caffeine. Keeping the cats quiet and contented, watch the changes produced in the next 2 hours.

4. Etherize a cat; adjust apparatus for recording respiration and circulation; take temperature records also. To jugular vein attach a burette containing 0.5 Gm. x kg. Chloral Hydrate in Locke's solution at 39° C. Obtain "normals"; stop ether, and then allow solution to run from burette at the rate of 1 mg. every 3 seconds. What evidences appear?

5. Let two students who room in the same neighborhood study the effect of Chloral Hydrate on man. Having secured the usual normals, let the subject take 1 Gm. Chloral, and let the observer carefully note ensuing phenomena, keeping track of the usual notations, including reflexes, onset of drowsiness, depth and character of sleep, and its duration.

6. In the hospital assignment, endeavor to ascertain if the presence in the body of disease toxins necessitates a larger or smaller dose of Chloral for the securing of a desired effect.

7. From the literature tabulate the advantages and disadvantages as a soporific of Chloral Hydrate and some of its congeners.

Experiment No. 1.

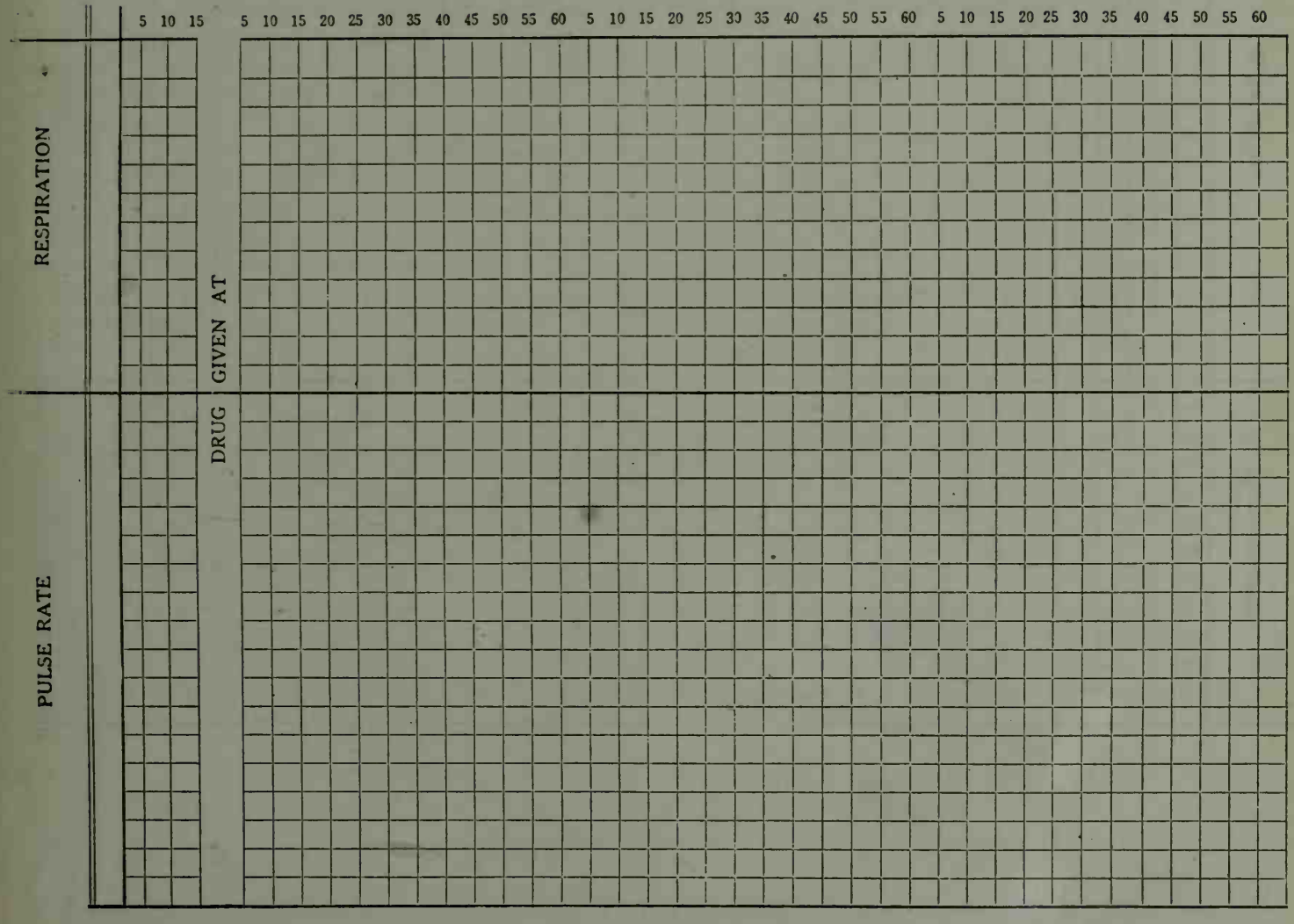
	Frog No. 1, 10 mg.				Frog No. 2, 20 mg.				Frog No. 3, 30 mg.			
	N.	20′	40′	60′	N.	20′	40′	60′	N.	20′	40′	60′
Respiration												
Touch reflex												
Position reflex												
Narcotism												
Condition next day												

Experiment No. 2.

Kymograph records:

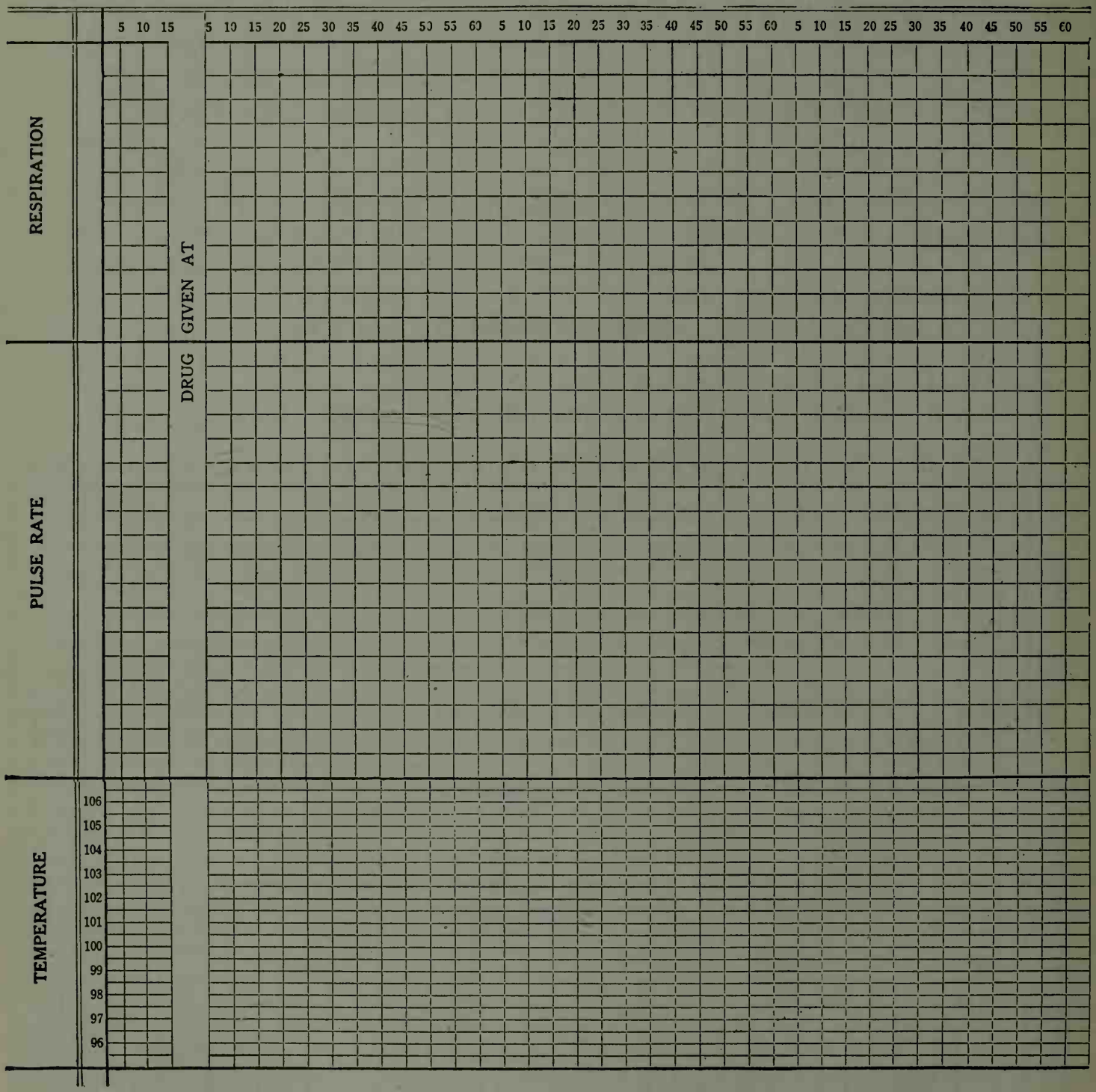
Experiment No. 3.

Cat *A*, (red ink curve 0.35 Gm. x kg. Chloral.
Cat *B*, (blue ink curve) 0.35 Gm. x kg. Chloral + Caffeine 0.12 Gm.



Indicate extent of soporific effect on ordinates every half hour.

Experiment No. 4.



EXPERIMENT No. 4 (*continued.*)

Kymograph records:

EXPERIMENT No. 5.

Chloral Hydrate, 1 Gm., administered to man:

	N.	30′	60′	90′	2 h.	3 h.	4 h.	8 h.	9 h.
Respiration: rate									
Respiration: quality									
Pulse: rate									
Pulse: quality									
Blood-pressure (omit when asleep)									
Temperature (axillary)									
Plantar reflex (tickling)									
Drowsiness									
Sleep									
Quality of sleep									

This experiment should be checked by repeating all the observations when no drug has been given, commencing at the usual bed-time.

Experiment No. 6.

Hospital observations:

		Before		After drug has been given.						
		Ob. 1	Ob. 2	20′	40′	60′	1.5 h	2 h	4 h	Awak.
Case I Illness ..... Duration ..... Condition	Respiration									
	Pulse									
	Temp. (axill.)									
	Drowsiness									
	Sleep									
Case II Illness ..... Duration ..... Condition	Respiration									
	Pulse									
	Temperature									
	Drowsiness									
	Sleep									
Case III Illness ..... Duration ..... Condition	Respiration									
	Pulse									
	Temperature									
	Drowsiness									
	Sleep									

Experiment No. 7.

	Advantages	Disadvantages
Chloral		
Paraldehyde		
Sulphonethyl-methane		
Sulphonmethane		

DIGITALIS.

1. Into the thigh lymph sac of a pithed frog inject 0.5 mil standardized Tincture Digitalis, diluted with an equal amount of Ringer's solution. Expose the heart, and keep it under observation for an hour or more, if necessary. Note variations in rates of auricles and ventricle; size, strength, and duration of diastole as compared with systole; color changes, etc. Keep heart moistened with Ringer's.

2. Pith a frog and secure normal heart tracings with a slow-timed drum, with an occasional curve on the fast drum. Administer by thigh lymph sac 0.5 mil diluted Tincture Digitalis. Continue tracings with slow drum, with occasional typical heart curves on the fast drum, until heart ceases beating. Compare results with those obtained in preceding experiment.

3. Pith a large frog; expose the heart, and secure normal tracings. Adjust apparatus for perfusion *in situ* with Infusion Digitalis (freshly made, and with salts added to the equivalence of Ringer's solution). Continue tracings until heart ceases beating, noting all objective and graphic variations.

4. Select 2 medium cats of equivalent weight and condition. Record normal heart-rate and respiration. To one give 0.5 mil Tincture Digitalis (diluted) by stomach; to the other give 3 mils freshly made Infusion Digitalis. Take regular observations of these two for several hours.

5. Select a large cat or medium-sized dog; etherize, and obtain the usual mechanical records of respiration and circulation. Into the jugular vein, at the rate of 1 mil a minute, run freshly made Infusion Digitalis (salted to be equivalent to Ringer's solution, and kept at 39° C.). Take continuous records until animal expires.

6. Take 2 subjects of approximately similar weight, condition, and temperament. Obtain normals of pulse-rate, pulse energy, volume wave (by sphygmogram), respiration, blood-pressure, and temperature. Also, by auscultation, study quality and rhythm of apex beat. Then to one administer by mouth 1 mil Tincture Digitalis; to the other, 8 mils of fresh Infusion Digitalis. Take regular records every 10 minutes for 3 hours; then every 6 hours, until circulatory condition returns to normal.

Report if there be any alteration in the degree of kidney activity.

7. In the hospital make as many studies as opportunity permits on sundry cases receiving Digitalis treatment, using all the methods indicated in preceding experiment.

Because of the cumulative effect of Digitalis, caution must be exercised in determining what may be the present "normal" for the patient under study.

8. Write a concise summary of your findings in the laboratory; state what divergencies you may have observed in the hospital; and check all these with references from recent literature.

Experiment No. 1.

	N.	5′	10′	15′	20′	25′	30′	35′	40′	45′	50′	55′	60′
Auricle													
Rate													
Diastolic %													
Systolic %													
Ventricle													
Rate													
Diastolic %													
Systolic %													

Color changes:.....

Remarks:.....

Experiment No. 2.

Heart tracings from injected Tincture Digitalis. Frog:

Experiment No. 3.

Heart tracings from perfused Infusion Digitalis. Frog:

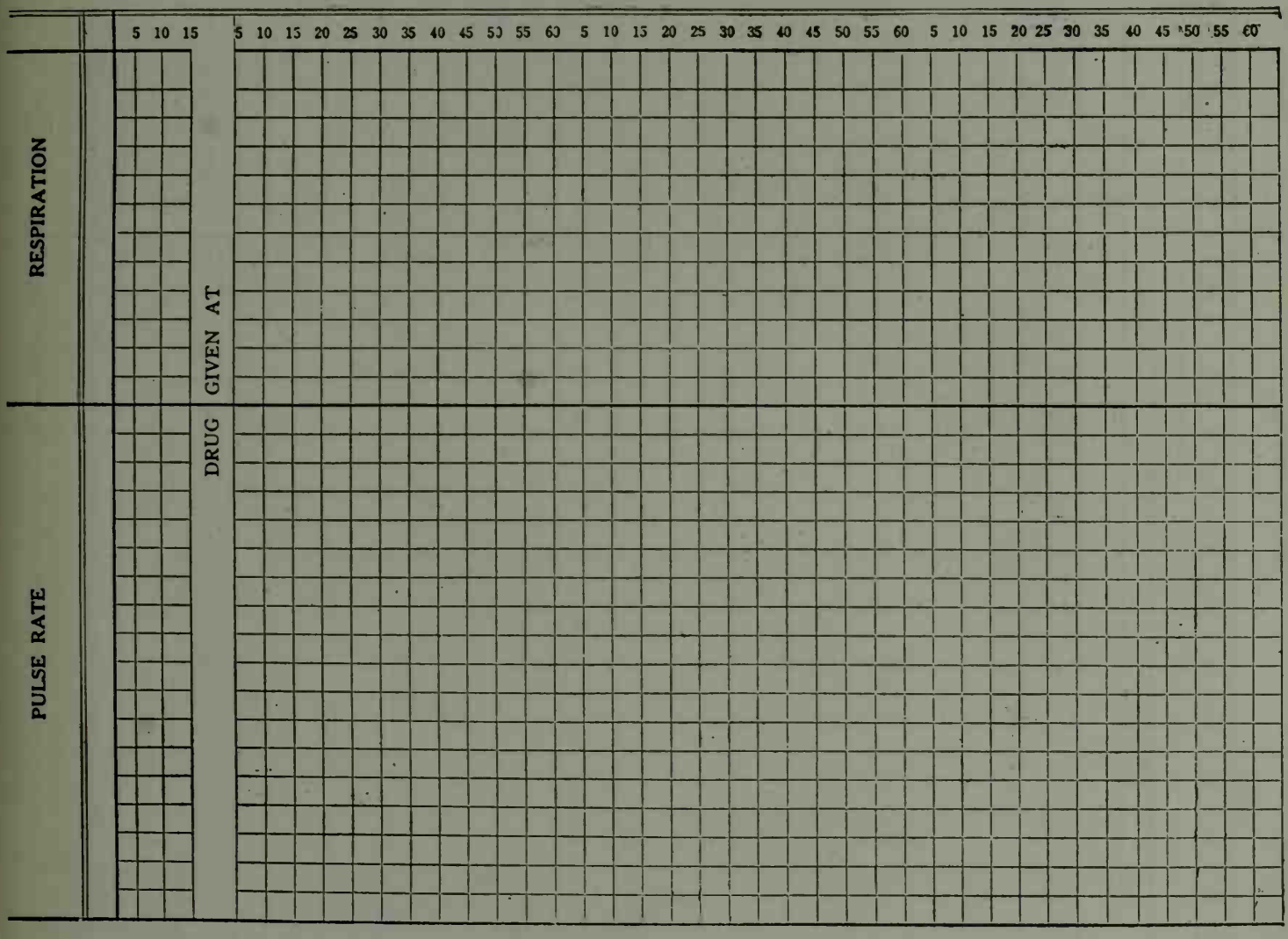
Experiment No. 4.

Sheet No. Date

Pharmacodynamics of Tincture Digitalis Dose, 0.5 mil x kg.
Pharmacodynamics of Infus. Digitalis Dose, 3 mils x kg. } Administration, Stomach Service

Subject, Cats Age Sex Weight Condition

Temperature, Humidity, Reporter



Red curve. Cat receiving the Tincture Digitalis.
Blue curve. Cat receiving the Infusion Digitalis.

Experiment No. 5.

Kymograph records of Infusion Digitalis intravenously:

Experiment No. 6.

Subject's initials or No. ..... Date .....

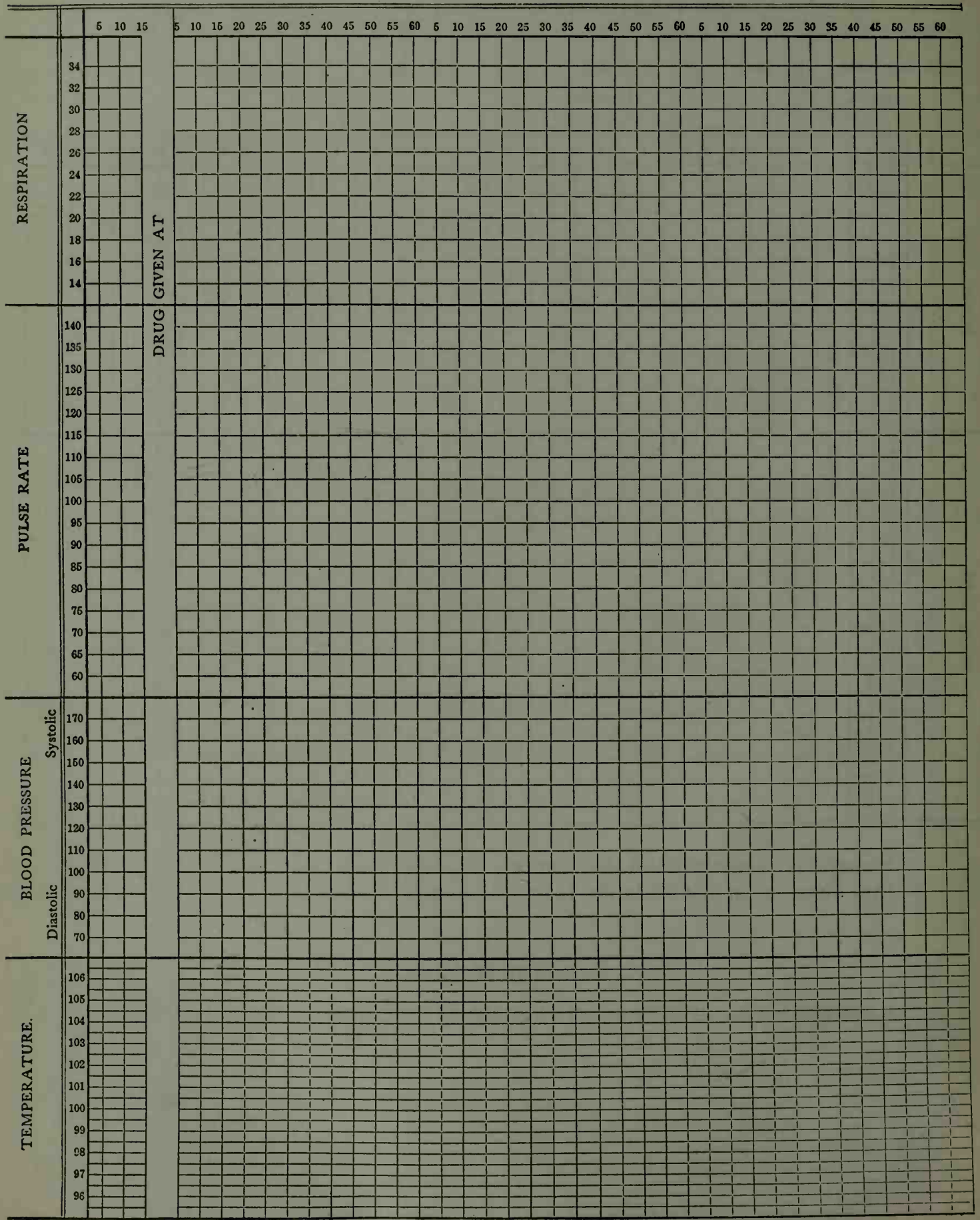
Age .....Sex .....Height .....Weight ..... Medicine[1] .....

Condition ..... Dose .....

Thermometer ..... How administered .....

Barometer ..... Remarks .....

Relative humidity ..... Reporter .....



[1] Red curve = Tincture; blue curve = Infusion.

Experiment No. 6.

Student taking 1 mil Tinct. =A; another, Infus. 7 mils =B.

A=Tinct. B=Infus.	Volume	Wave	Volume Energy	Apex Rhythm	Apex Quality
Normal	A	B	A	A	A
			B	B	B
½ hour	A	B	A	A	A
			B	B	B
1 hour	A	B	A	A	A
			B	B	B
1.5 hours	A	B	A	A	A
			B	B	B
2 hours	A	B	A	A	A
			B	B	B
3 hours	A	B	A	A	A
			B	B	B
6 hours	A	B	A	A	A
			B	B	B
12 hours	A	B	A	A	A
			B	B	B
18 hours	A	B	A	A	A
			B	B	B.
24 hours	A	B	A	A	A
			B	B	B
30 hours	A	B	A	A	A
			B	B	B
36 hours	A	B	A	A	A
			B	B	B
42 hours	A	B	A	A	A
			B	B	B
48 hours	A	B	A	A	A
			B	B	B

Experiment No. 7.

Illness ..... Duration of ..... Condition .....

	Present	0.5 hour	1 hour	1.5 hour	2 hours	3 hours
Dose=						
Respiration						
Heart-rate						
Blood-press. S.						
Blood-press. D						
Pulse volume						
Apex rhythm						
Apex quality						
Sphygmogram						
Electrocardiogram						

Later history: .....

Duplicate this study as many times as possible.

Experiment No. 8.

	Laboratory	Hospital	Literature
Respiration			
Heart-rate			
Blood-press.			
Pulse volume			
Diuresis			
Apex rhythm			
Vol. wave			

EPINEPHRIN.

1. Expose the heart of a pithed frog; connect with heart lever, and obtain a normal tracing. Apply to the heart 2 minims Epinephrin solution, 1 to 1000, and continue tracings, noting whatever effect may be produced.

2. Repeat Experiment No. 1, except to inject 0.1 mil of the Epinephrin solution into the thigh lymph sac.

3. Obtain a normal heart tracing from a pithed frog. Administer by lymph sac 0.2 mil 0.01 sol. Atropine Sulphate. Obtain brief records every few minutes. After ½ hour, apply some Epinephrin solution, and observe resulting tracing. Compare it with that obtained in Experiment No. 1.

4. Etherize a dog, and make connections with respiratory and circulatory recording apparatus. To one carotid attach a mercury manometer; to the other attach a Hürthle manometer, and adjust it for marked upward excursion. Secure normals, then, with continuous drum, with hypodermic needle inject into jugular vein 0.05 mil per kg. Epinephrin solution, 1 to 1000, marking drum at moment of injection.

When normal conditions return, repeat injection, comparing time and extent of response.

When normal conditions return, readjust the Hürthle manometer for downward excursions. Administer *via* jugular vein with hypodermic 0.5 mil per kg. of Nitroglycerin, 1 to 1000 solution. When blood-pressure is at its lowest point, inject 0.05 mil per kg. Epinephrin solution, 1 to 1000.

When normal conditions return, reverse the preceding experiment.

Cause death with Epinephrin solution, noting phenomena.

5. Select a group of three students of equivalent weight, temperament, and condition. Record their normals; then administer 0.5 mil Epinephrin solution, 1 to 1000 —to one by mouth, to a second subcutaneously, to a third intramuscularly. Take note of all reactions. Compare with others. See particularly if reaction seems to be modified in any way by temperament or physique.

6. Study the uses of Epinephrin in the operative clinics of ophthalmology and rhinology.

Ascertain also in what ward, and for what conditions, the further utility of Epinephrin is being studied. Learn the present status of such investigations, and compare results with what you have thus far obtained.

7. Marshal in systematic form the leading facts known about the pharmacodynamics of Epinephrin, giving your authority in each case.

Experiments No. 1, 2 and 3.

Kymograph records. Frog:

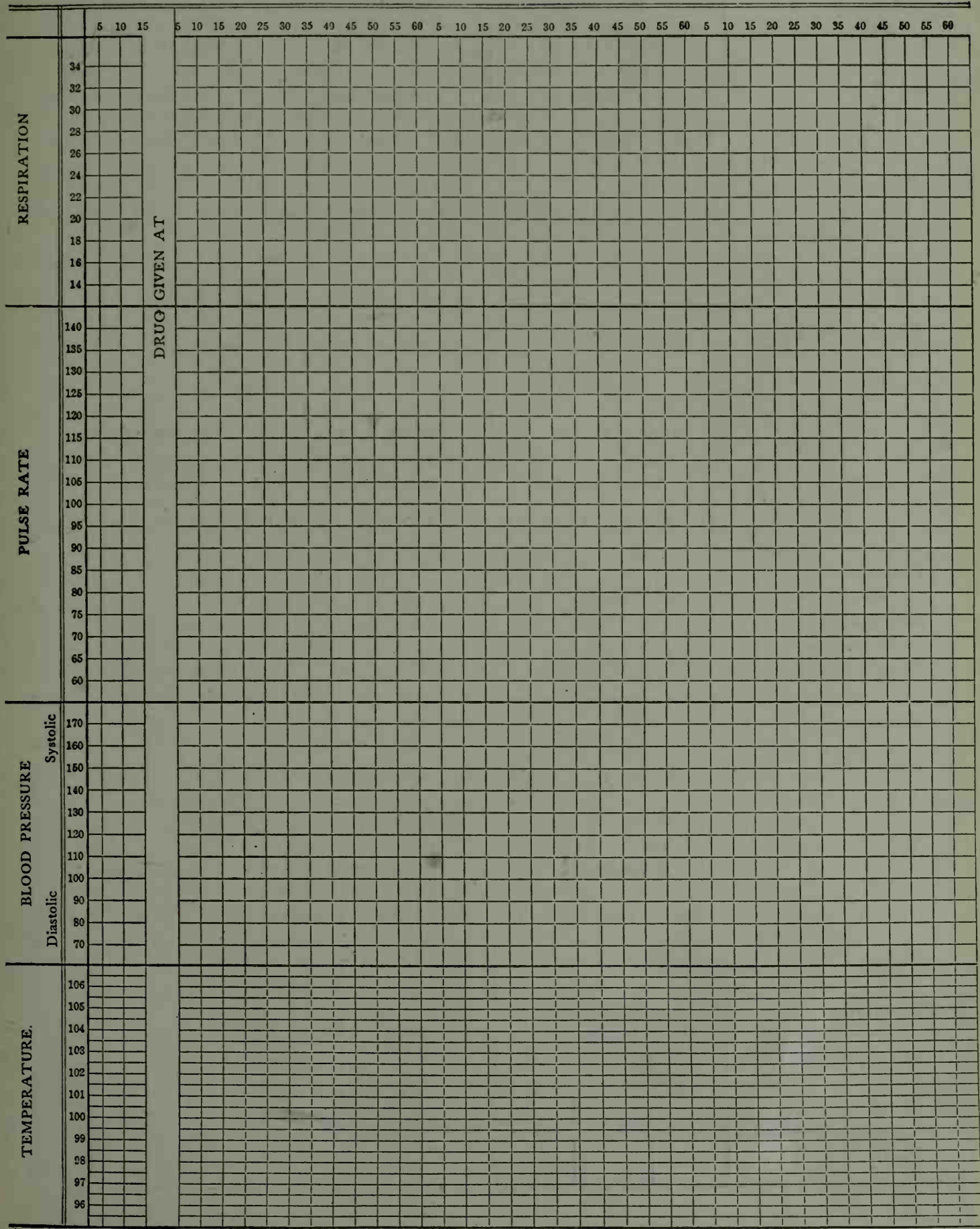
EXPERIMENT No. 4.

Kymograph records. Dog:

Experiment No. 5.

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



Experiment No. 5.

	By mouth			Subcutaneously			Intramuscularly		
	Subject 1; wt. age, ; sex, temperament,			Subject 2; wt. age, ; sex, temperament,			Subject 3; wt. age, ; sex, temperament,		
	Max.°	Time ′	Norm.′	Max.°	Time ′	Norm.′	Max.°	Time ′	Norm.′
Pulse									
Respiration									
Blood-press. S.									
Blood-press. D.									
Pupil									
	Subject 4; wt. age, ; sex, temperament,			Subject 5; wt. age, ; sex, temperament,			Subject 6; wt. age, ; sex, temperament,		
	Max.°	Time ′	Norm.′	Max.°	Time ′	Norm.′	Max.°	Time ′	Norm.′
Pulse									
Respiration									
Blood-press. S.									
Blood-press. D.									
Pupil									
	Subject 7; wt. age, ; sex, temperament,			Subject 8; wt. age, ; sex, temperament,			Subject 9; wt. age, ; sex, temperament,		
	Max.°	Time ′	Norm.′	Max.°	Time ′	Norm.′	Max.°	Time ′	Norm.′
Pulse									
Respiration									
Blood-press. S.									
Blood-press. D.									
Pupil									

EXPERIMENT No. 6.

Report of observations in operative ophthalmology:

Report of observations in operative rhinology:

Report of other observations in the hospital:

EXPERIMENT No. 7.

Summary of pharmacodynamics of Epinephrin:

THE NITRITE SERIES.

1. Prepare a frog for heart tracings, and secure normals on both the slow and fast drum. Into the anterior lymph sac inject 0.1 mg. Nitroglycerin. Take frequent sample graphs on both drums.

2. Place a cat in the etherizing box, and into the cone drop 3 minims Amyl Nitrite. Administer immediately for ½ minute, then quickly place cat under a cage, and watch her recovery.

3. Obtain the normals of pulse and respiration of a rabbit; then administer subcutaneously 0.5 mg. Nitroglycerin. Plot your findings on the chart.

4. Etherize a cat; secure the usual registrations. Keeping apparatus running (Hürthle manometer should be adjusted for low drop), drop into ether cone 3 minims Amyl Nitrite, and obtain the registered effect. This may be repeated several times.

5. When the normal returns (in Experiment No. 4), administer to the cat 0.25 mg. x kg. Nitroglycerin intraperitoneally. Keep constant drum until registration marks normal.

6. With the return of normal, administer the same dose intravenously. When the drug action is at its maximum, administer by jugular vein 0.3 mil Epinephrin solution, 1 to 1000.

7. Form a group of six. *A,* the subject, is to inhale 3 minims Amyl Nitrite, gazing meanwhile at a black spot on a large white surface; *B,* to take continuous pulse-count, announcing the count in continual 5-second intervals; *C,* to record the pulse as announced; *D,* to take continuous blood-pressure readings, quickly following the rapid variations; *E,* to record the pressure findings; *F,* to obtain sphygmograms and to note subject's facial appearance. Let subject break an Amyl Nitrite pearl in a towel, and immediately inhale the fumes, continuing for ½ minute unless he feels too dizzy. Both reaction and recovery will be rapid, so observers must maintain keen attention.

8. Nitroglycerin in therapeutic doses is not dangerous, but it sometimes produces a rather severe headache; this lessens with tolerance. Therefore if one accustomed somewhat to the drug, or if some one else will volunteer, let the usual observations be made concerning the effects of Nitroglycerin. Dose, 0.5 mg.

9. In the hospital assignment, determine the reactions of Nitroglycerin in the several instances where it may have been prescribed. Compare these reactions with those you have observed in the laboratory. Endeavor to ascertain, also, how extent and duration of Nitroglycerin action may be modified in any given case by habituation.

10. Consulting the literature, ascertain the rationale of the use of Nitroglycerin, and seek to explain any apparent discrepancies.

Experiment No. 1.

Graphs. Frog:

EXPERIMENT No. 2.

Report of Amyl Nitrite on a cat:

EXPERIMENT No. 3.

Nitroglycerin, 0.5 mg. hypodermic. Rabbit:

EXPERIMENT No. 4.

Kymograph record: Amyl Nitrite. Cat:

EXPERIMENT No. 5.

Kymograph record: Nitroglycerin. Cat:

Experiment No. 6.

Kymograph record: Nitroglycerin, then Epinephrin. Cat:

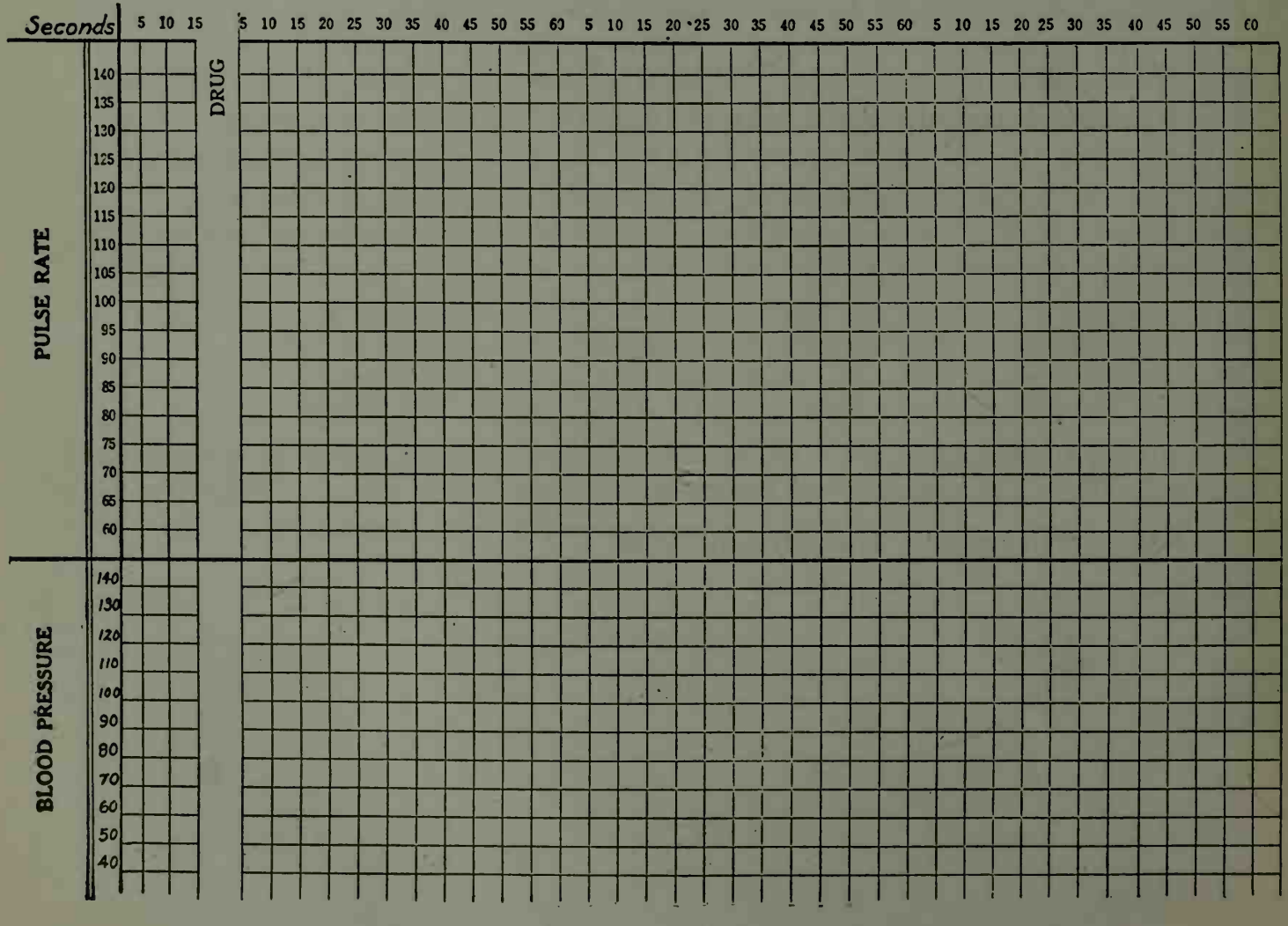
Experiment No. 7.

No. Date

Pharmacodynamics of Amyl Nitrite Dose, 3 minims Administration, Inhaled Service

Subject Age Sex Weight Condition

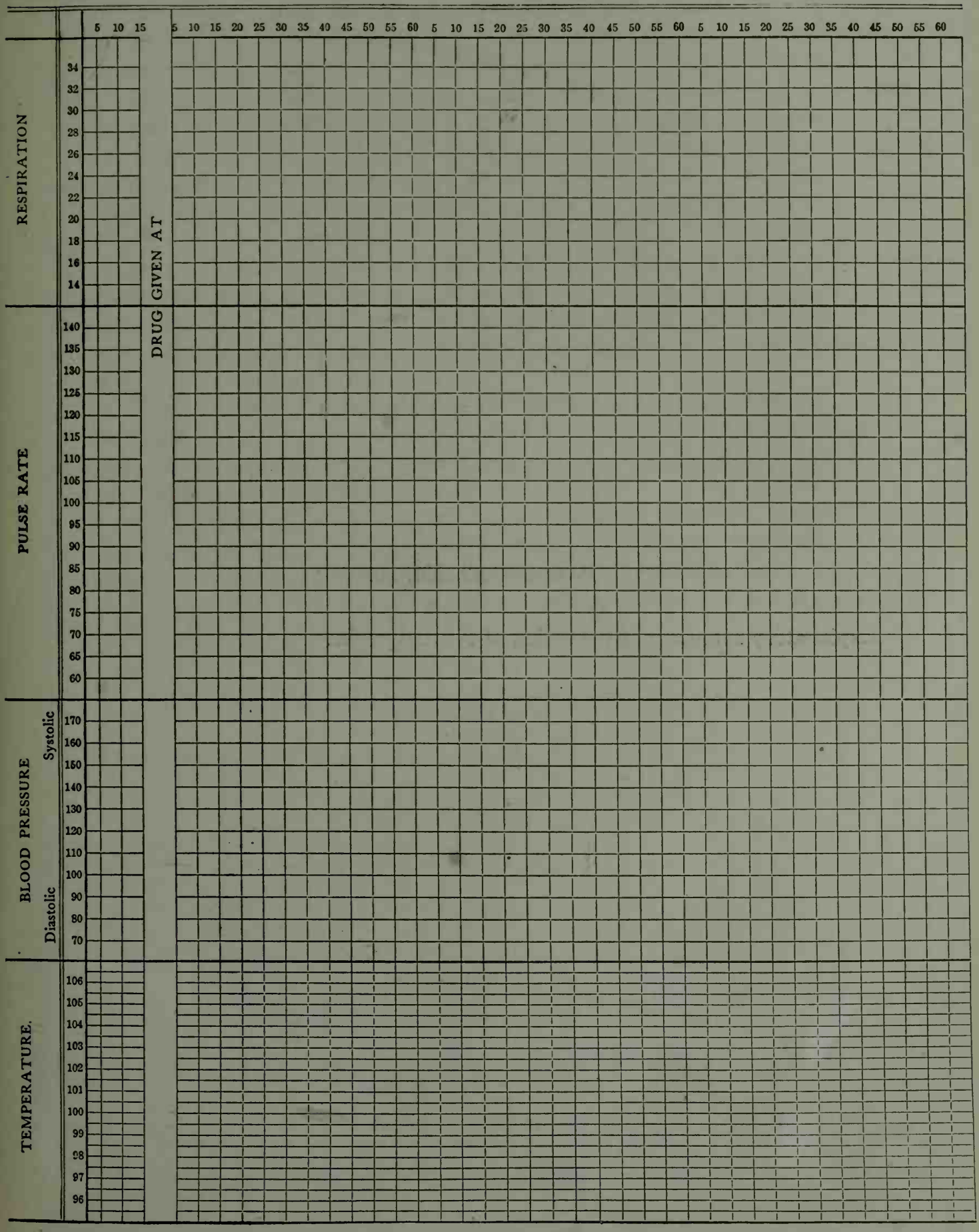
Temperature, Humidity, Reporter



Experiment No. 8.

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



EXPERIMENT No. 9.

Report of observations in the hospital:

EXPERIMENT No. 10.

Explanatory summary of the action of Nitroglycerin:

ACONITE.

1. Into the anterior lymph sac of a frog inject 0.3 mil Tincture Aconite, diluted with equal amount normal saline. Observe effect on the various reflexes.

2. Expose the heart of a pithed frog; secure normal tracings on both the slow and fast drum. Into the thigh lymph sac inject 0.3 mil Tincture Aconite diluted. Continue tracings on slow drum, with an occasional cardiac curve on fast drum, noting carefully any variations in the graph, or in the physical condition of the heart.

3. Select two fasting rabbits, of equal weight and condition. Obtain normals of respiration and heart-rate. Then to one administer by stomach 0.1 mil x kg. Tincture Aconite; to the other give hypodermically 0.1 mg. x kg. Aconitine. Continue regular observations for several hours.

4. Select a large healthy cat or rabbit. Etherize carefully; connect with recording apparatus, and secure usual normals, including temperature. Continuing the records, slowly administer by vein a 20% dilution in warm Ringer's solution of Tincture Aconite. Keep account of amount of drug used, and note gradual accumulation of effect. Continue until animal dies.

5. Place a drop of Tincture Aconite on the tongue, and note effect.

6. On a student secure normals of respiration, pulse phenomena (rate, volume, energy), blood-pressure, and temperature. Administer orally 0.6 mil Tincture Aconite. Continue observations.

7. Although the use of Aconite has become markedly restricted, it may occasionally be studied in the wards of acute respiratory disorders. Particular attention should be paid to any registerable effect discoverable in relation to the circulation.

8. Look up recent literature, and make a brief presentation of the arguments for and against the use of Aconite.

Experiment No. 1.

Describe the effects of Aconite on a frog:

Experiment No. 2.

Kymograph record of Aconite action on frog:

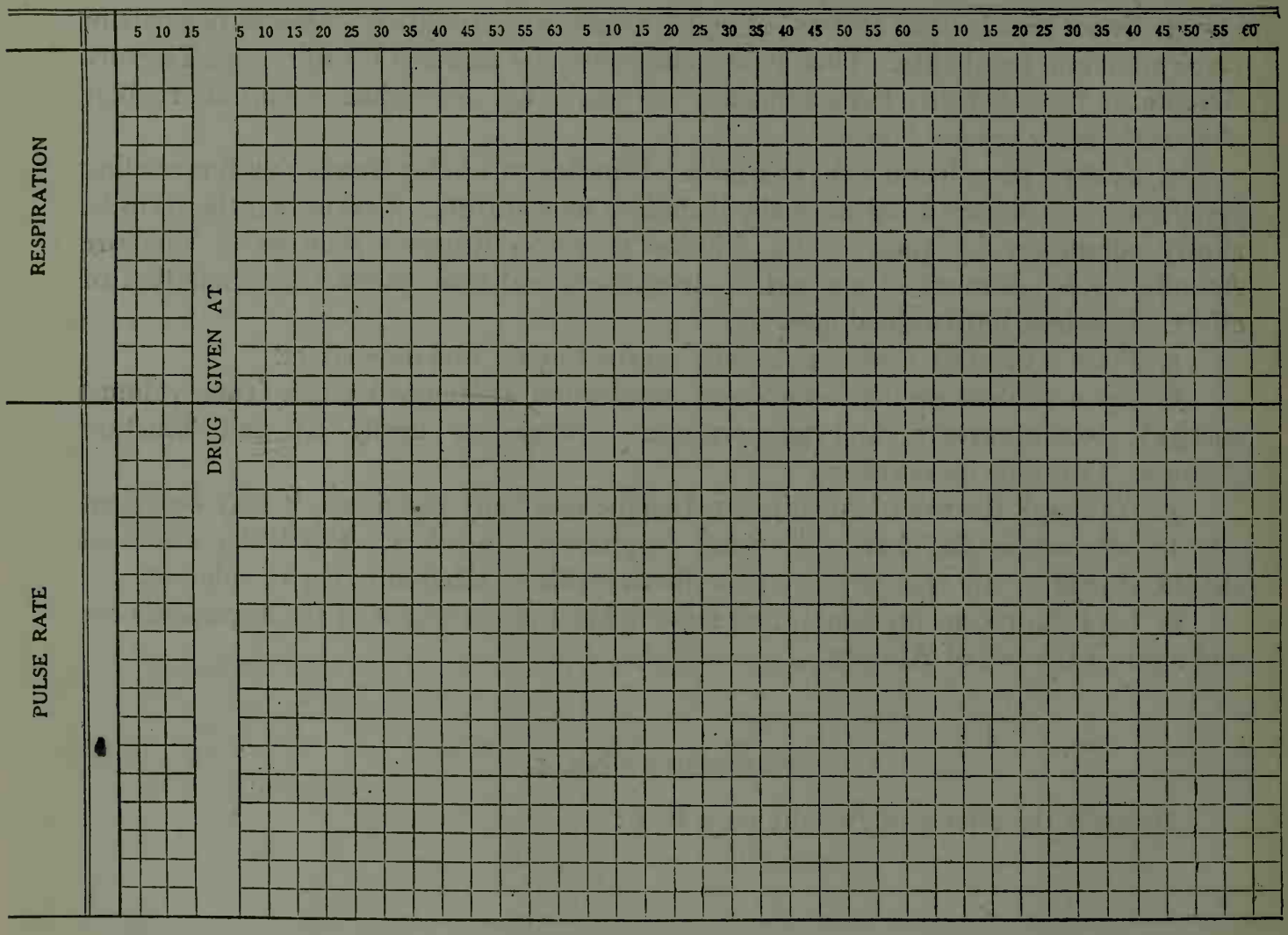
Experiment No. 3.

No. Date

Pharmacodynamics of Aconite Dose Administration

Subject { Rabbit (red = Tinct. Acon. / Rabbit (blue = Aconitine Age Sex Weight Condition

Temperature Humidity Reporter



Experiment No. 4.

Kymograph records: Tincture Aconite, intravenously. Rabbit:

Experiment No. 5.

Report:

Experiment No. 6.

Subject's initials or No. ..... Date .....

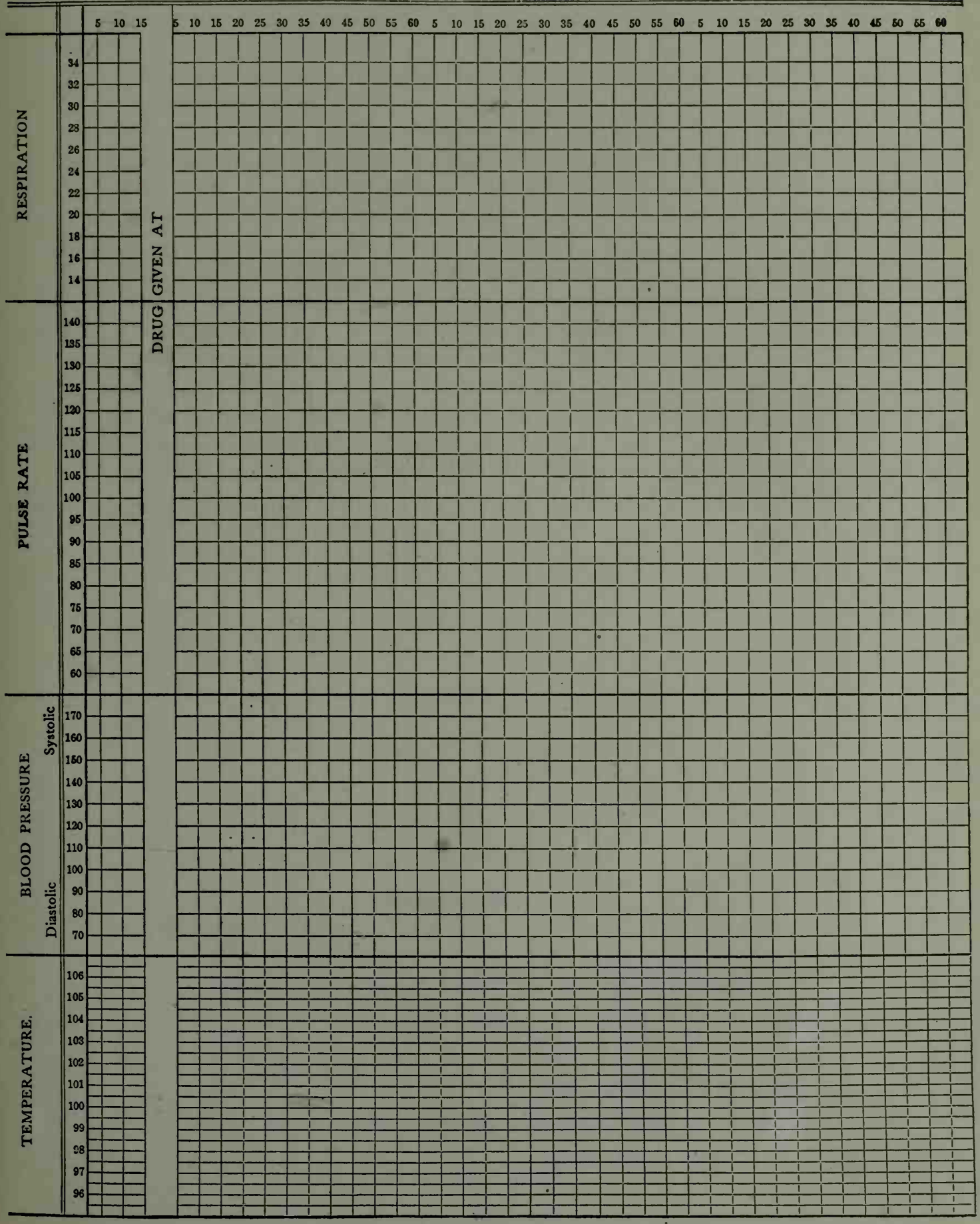
Age ..... Sex ..... Height ..... Weight ..... Medicine .....

Condition ..... Dose .....

Thermometer ..... How administered .....

Barometer ..... Remarks .....

Relative humidity ..... Reporter .....



EXPERIMENT No. 7.

Hospital report:

EXPERIMENT No. 8.

Concerning the use of Aconite: Arguments *pro* and *con*:

ANTIPYRIN.

1. Determine the effects on respiration and the reflexes of a frog of 0.1 Gm. Antipyrin injected into the anterior lymph sac.

2. Determine effect produced by bathing a frog's heart with a 1% solution of Antipyrin.

3. Determine the effects of Antipyrin on all the systems of a rabbit when 0.5 Gm. x kg. are administered by mouth.

4. Etherize a cat or rabbit. Connect with the several recording apparatus; obtain the usual normals. With the jugular vein connect a burette containing a 10% solution Antipyrin in warm Ringer's. Take continuous records while the solution runs in at the rate of 1 mil every 2 minutes. Report your conclusions, with graphic supporting evidence.

5. Select a subject who is not anæmic, and obtain the usual normals, including hemoglobin test and spectroscopic hæmic test. Administer 0.5 Gm. Antipyrin (or 0.75 Gm. Acetphenetidin). Continue taking the usual records. Two hours after the drug has been taken secure another sample of blood for both hæmoglobin and spectroscopic tests. In your report include your spectroscopic drawings.

6. In the hospital, study circulation and temperature reactions of patients to whom have been administered coal-tar preparations.

7. What are the relative merits and demerits of the several coal-tar products used in medicine?

Experiment No. 1.

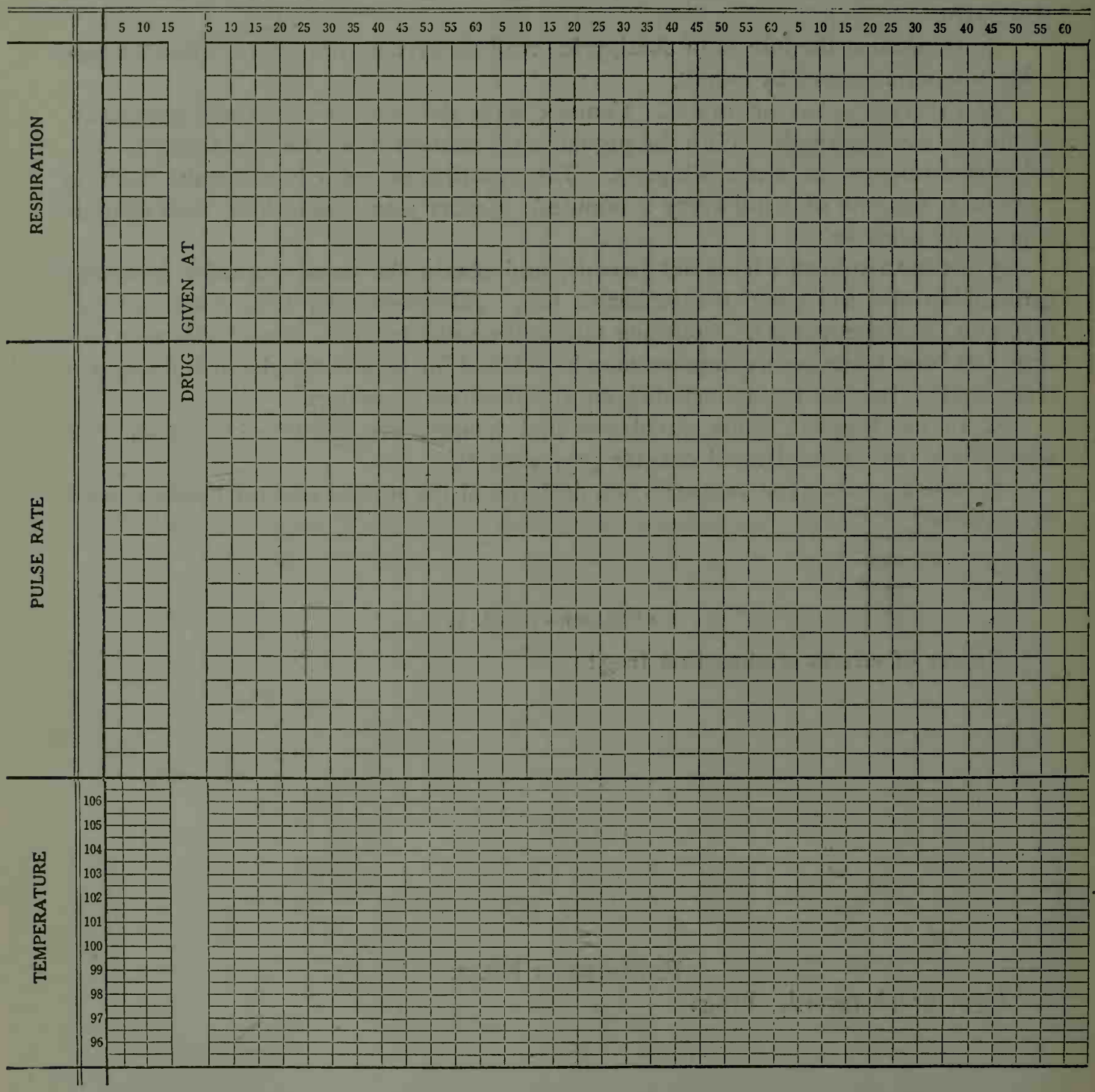
Report of effects produced on frog:

Experiment No. 2.

Kymograph record. Frog:

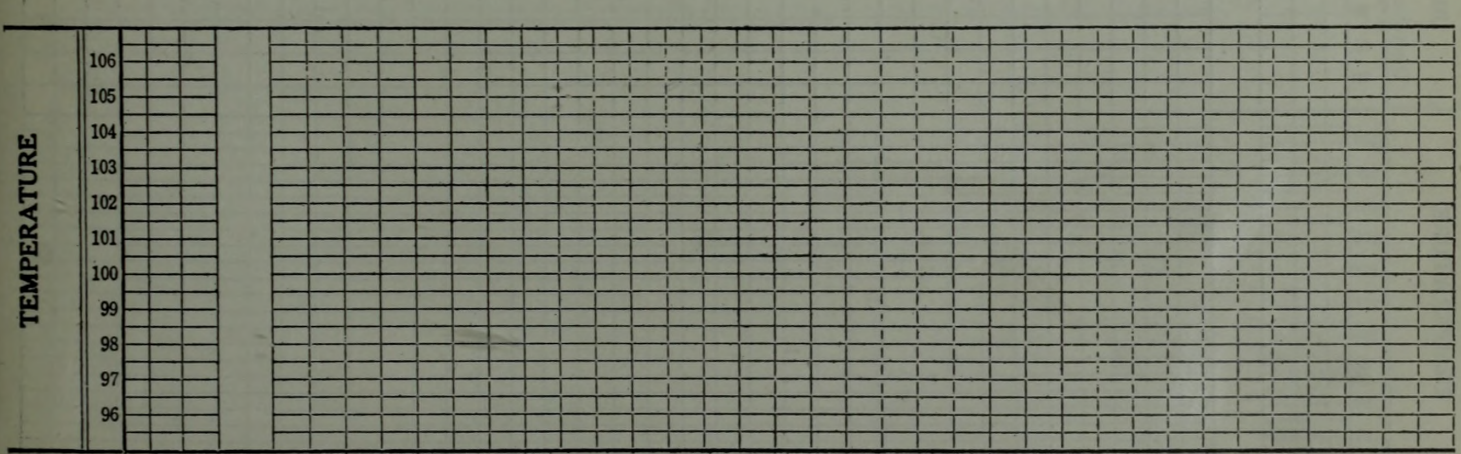
Experiment No. 3.

Report of effect of 0.5 Gm. per kg. on rabbit:



Experiment No. 4.

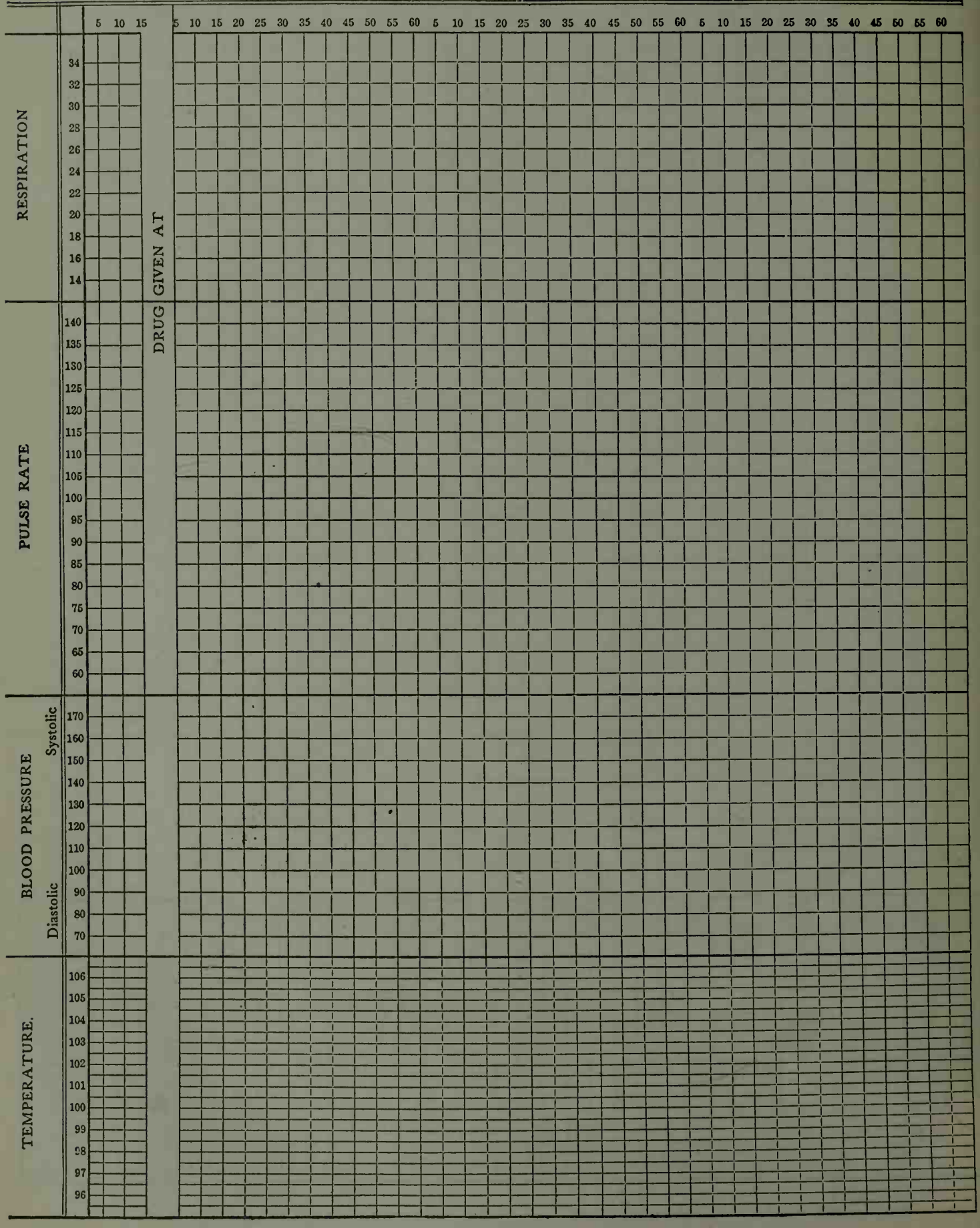
Kymograph records intravenous injection. Cat:



Experiment No. 5.

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



Experiment No. 6.

Hospital reports:

			Heart-rate			Blood-pressure			Temperature		
	Drug	Dose	Now	15′	30′	Now	15′	30′	Now	15′	30′
Case No. I											
Case No. II											
Case No. III											
Case No. IV											
Case No. V											

	Case I	Case II	Case III	Case IV	Case V
Illness					
Day of illness					
Use of drug					
Hæmoglob. *A*					
Hæmoglob. *P*					
Spectrum *A*					
Spectrum *P*					

Experiment No. 7.

Drug	Merits	Demerits

COCAINE.

1. Make two muscle preparations. Place them in glass capsules, and obtain normal curves with both the slow and fast drums. Then fill one capsule with Ringer's solution, and the other with Ringer's containing 0.1% solution Cocaine Hydrochloride. Take records every half minute, letting every third record be on the fast drum. Compare results for indications.

2. Make two nerve-muscle preparations. Place both in watch-glasses containing Ringer's solution, but have the nerves exposed on filter paper liberally wet—one with Ringer's, the other with 2% Cocaine solution. Make tests every 20 seconds of nerve conductivity, using weak single-shock break stimuli.

3. Expose heart of pithed frog, and obtain normal tracings. Continuing tracings, flood heart with 2% solution Cocaine.

4. Obtain normal tracings of heart of pithed frog. Inject 1 mil 0.3% solution Cocaine into lymph sac of thigh.

5. Into a rabbit's eye place 1 drop of a 2% solution Cocaine. Essay an explanation of ensuing phenomena.

6. Using an etherized cat, obtain the usual mechanical registrations; also temperature. Into the jugular vein run a warm 0.5% solution Cocaine (in Locke's solution) at the rate of 1 mil every 2 minutes. Continue until animal dies.

7. Place some 2% solution on the lip and on the side of the tongue. After 3 to 5 minutes, test parts for sensitivity.

8. Using a small dog, inject subcutaneously 2.5 mg. x kg. Cocaine. Follow temperature variations for 2 hours.

9. In the minor surgery clinic, and in the clinics of operative ophthalmology and rhinology, secure data concerning the utility of Cocaine in obtunding sensation.

10. Consult the literature for the relative merits of the various Cocaine substitutes.

Experiment No. 1.

Kymograph records of Cocaine action on frog muscle:

Experiment No. 2.

Report of Cocaine action on nerve conductivity:

EXPERIMENT No. 3.

Kymograph records of Cocaine action on heart muscle direct

EXPERIMENT No. 4.

Heart curve as affected by Cocaine in lymph sac. Frog:

EXPERIMENT No. 5.

Effect of Cocaine in eye of rabbit:

EXPERIMENT No. 6.

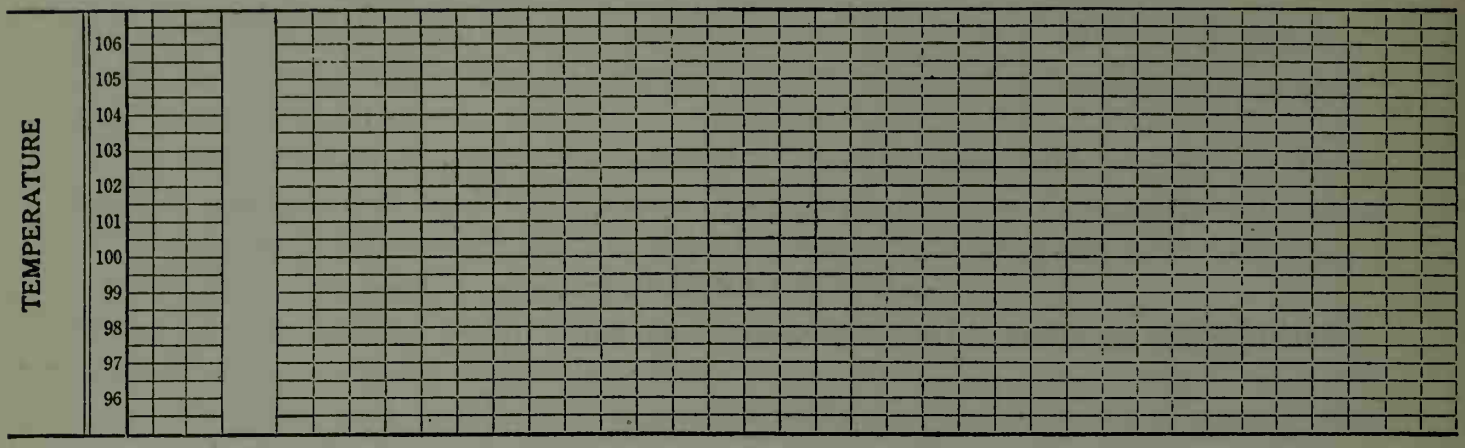
Kymograph records of Cocaine intravenously. Cat:

EXPERIMENT No. 7.

Report of Cocaine action on sensitivity of mucosa:

Experiment No. 8.

Effect of Cocaine on temperature. Dog:



Experiment No. 9.

Report from minor surgery clinic:

Report from clinic of operative ophthalmology:

Report from clinic of operative rhinology:

Experiment No. 10.

	Anæsthetic action	Rapidity of action	Toxicity	Irritancy	Effect on pupil
Cocaine					
Eucaine					
Novocaine					
Stovaine					
Holocaine					

ALCOHOL.

1. Pith the brain of a frog. Obtain normal heart tracings; bathe heart with 20% Alcohol, and note results.

2. Obtain normal heart tracings from a pithed frog. Administer by stomach 1 mil 20% Alcohol. Continue tracings on both slow and fast drums.

3. Repeat Experiment No. 2, except to administer drug by thigh lymph sac.

4. In the anterior lymph sac of one frog inject 2 mils 25% Alcohol. Give the same dose by stomach to another frog of equal weight and condition. What results? Observe again next day.

5. Having secured the normals of a rabbit, administer by stomach 5 mils x kg. 40% Alcohol, and note variations produced on all systems, including temperature. When the animal becomes stupefied, inject hypodermically 0.3 Gm. Caffeine.

6. Anæsthetize a cat or dog. Obtain the usual mechanical registrations of normals; also note temperature. Into the jugular vein, at the rate of 1 mil a minute, run 25% Alcohol, using warm Locke's solution for diluent, discontinuing the ether. Continue administration until animal dies. Endeavor to determine from your tracings at what systemic point the drug exerts its toxic effect. Compute amount of Alcohol used.

7. Select two subjects, one short and stout, the other tall and thin. Obtain normals of all the systems as usual. Test their reaction times to touch, hearing, and sight; test their mental activity with the antonym test, the imagery test, and the multiplication test; test strength with the grip dynamometer. Administer 20 mils French brandy, well diluted. Continue observations for two hours, taking the extra tests every half-hour. (This test is somewhat vitiated by the subject's anticipation. How might this be remedied?)

8. Since Alcohol has no advantageous utility in internal medicine, hospital observation will be available in the dipsomaniac wards only. Here study should be made of the pharmacodynamic reactions which may be registerable in both acute and chronic alcoholism.

9. Summarize and criticise three recent articles on the use of Alcohol in medicine, giving in each case your authority for position maintained.

Experiment No. 1.

Heart tracings, with local application of drug. Frog:

Experiment No. 2.

Heart tracings, with drug by stomach. Frog:

Experiment No. 3.

Cardiac tracings, with drug by lymph sac. Frog:

Experiment No. 4.

Effect of drug by stomach and by lymph sac. Frogs:

	Frog No. 1, stomach				Frog No. 2, lymph sac			
	Norm.	20′	40′	60′	Norm.	20′	40′	60′
Respiration								
Swimm. reflex								
Gen'l. reflex								
Activity								
Appearance next day								

Experiment No. 5.

Effect on rabbit of internal administration of drug:

Experiment No. 6.

Kymograph records of effect on:

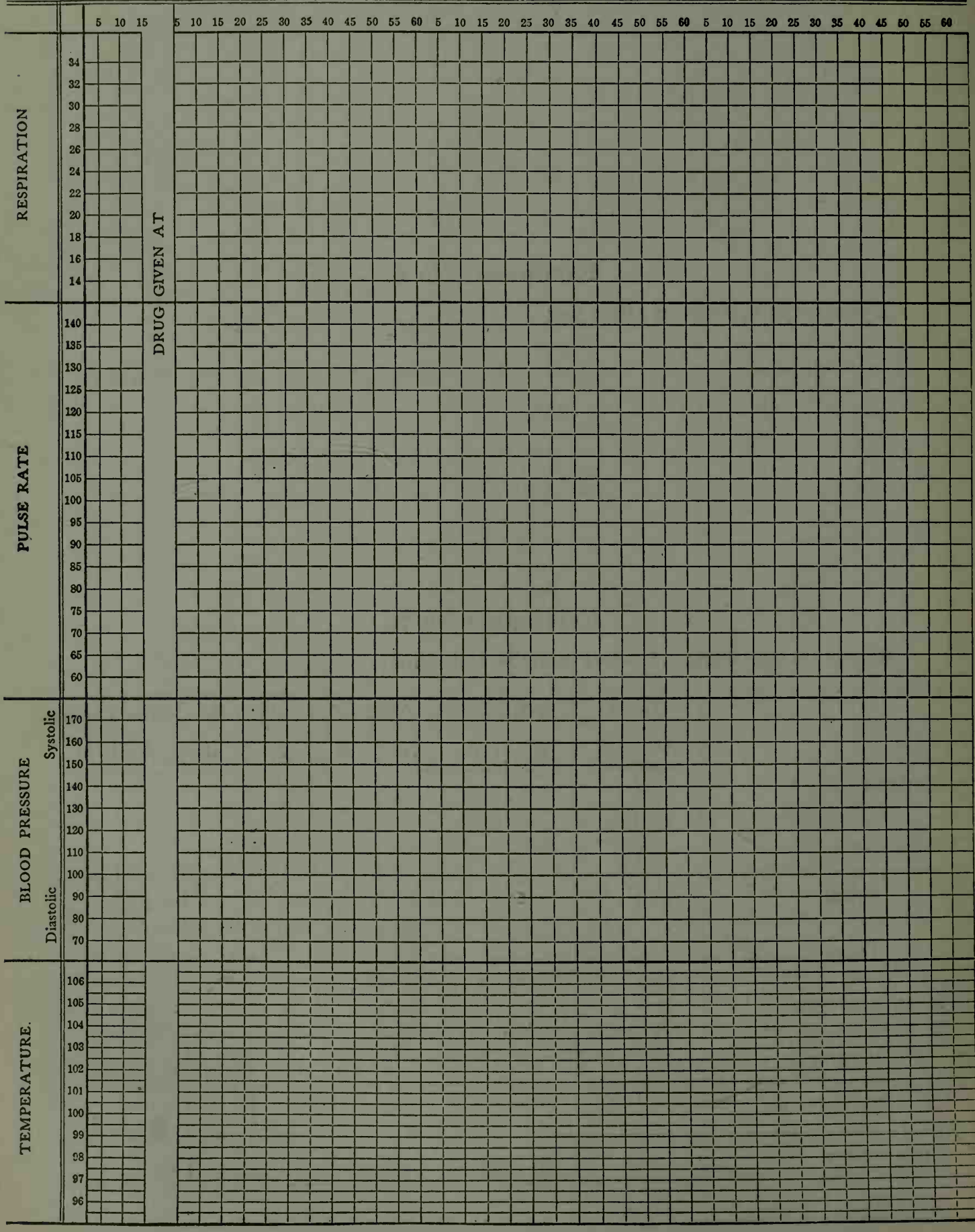
Experiment No. 7.

Report on two men: *A*, short man; *B*, tall man:

	Normal		After 30′		After 60′		After 90′		After 2 hours	
	A	B	A	B	A	B	A	B	A	B
Æsthesia										
React. Sight										
Sound										
Touch										
Mens, Antonyms										
Imagery										
Multiplication										
Dynamometer										

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



Experiment No. 8.

Hospital reports. Reports concerning acute alcoholism:

		Respiration				Heart-rate				Blood-pressure							
		Hour of observation															
Case	Age	3rd	6th	9th	12th	3rd	6th	9th	12th	3rd		6th		9th		12th	
										S	D	S	D	S	D	S	D
I																	
II																	
III																	
IV																	
V																	

Reports concerning chronic alcoholism:

		Respiration				Heart-rate				Blood-pressure							
		Day of observation															
Case	Age	2nd	4th	6th	8th	2nd	4th	6th	8th	2nd		4th		6th		8th	
										S	D	S	D	S	D	S	D
I																	
II																	
III																	
IV																	
V																	

Experiment No. 9.

Summary and criticism of arguments anent Alcohol:

CANNABIS.

1. Determine what effect Cannabis has on the heart of a frog when the drug is administered by stomach in the dose of 0.3 mil of the Tincture.

2. Determine the effect on the reflexes of a frog when 0.3 mil Tincture Cannabis is administered by lymph sac.

3. Determine the effect of Cannabis on all the systems of a cat, dog, or rabbit, when the drug is administered by stomach in doses of 0.3 mil x kg.

4. Etherize a dog or large cat, and obtain usual registrations. Administer by stomach 2 mils x kg. of an assayed Tincture of Cannabis. Stop the ether. Continue records. Any pupil variations?

5. Let a subject volunteer. Obtain the usual normals, and take record of his reflexes, size of pupil, and sensations of pain and of tactual space-discrimination. Let him describe a small simple picture at which he has gazed intently for 5 seconds. Administer 1 mil Tincture Cannabis. Continue usual observations every 10 minutes. At 40-minute intervals test his powers of description. Test also the relative keenness of pain and touch.

Do not engage him in conversation, but if he wishes to talk, note character, conformity, and reasonableness of whatever he says. If he experiences subjective sensations, let him describe them. Keep a careful record of all phenomena, noting also the advent of drowsiness, the time and character of sleep (omit blood-pressures now), and the mental and physical condition of the subject on awakening.

6. Interesting divergencies from the preceding experiment may be discovered by having a subject smoke (and inhale the smoke) 0.065 Gm. powdered Cannabis.

7. In the hospital assignment compare results obtained in Experiment No. 5 with the efficiency of the drug, as well as its physiological actions, when it is used to quiet cases of hysteria and nervous excitement.

8. In the psychopathic ward study available manifestations of the "hashish" habit.

9. From recent literature summarize at least three articles discussing the use of Cannabis in medicine.

Experiment No. 1.

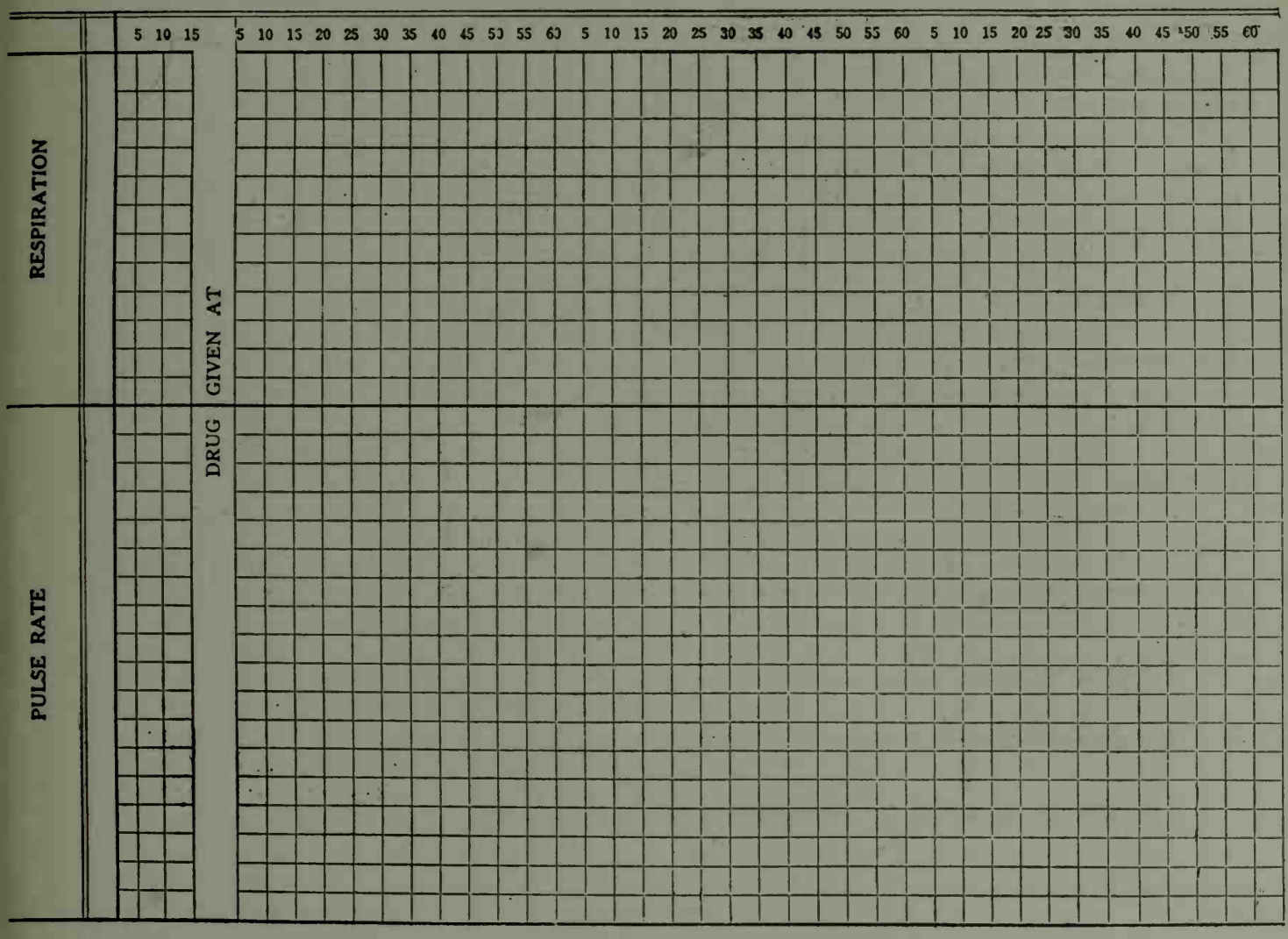
Heart tracings from stomach administration. Frog:

Experiment No. 2.

Report of effect on reflexes, drug by lymph sac. Frog:

Experiment No. 3.

Stomach administration to a .



Experiment No. 4.

Kymographic records of stomach administration to

General statement:

Experiment No. 5.

	Normal	40′	80′	120′	160′	
Cervico-pupil reflex						
Light-pupil reflex						
Plantar-tickling reflex						
Size of pupil						
Tactile discrimination						
Pain sensation, gms.						
Volubility						
Drowsiness						
Sleep						

Length of sleep: .....

Quality of sleep: .....

Discussion of effect on loquacity: .....

.....

Discussion of effect on mentality: .....

.....

Discussion of subjective sensations: .....

.....

.....

.....

General statement: .....

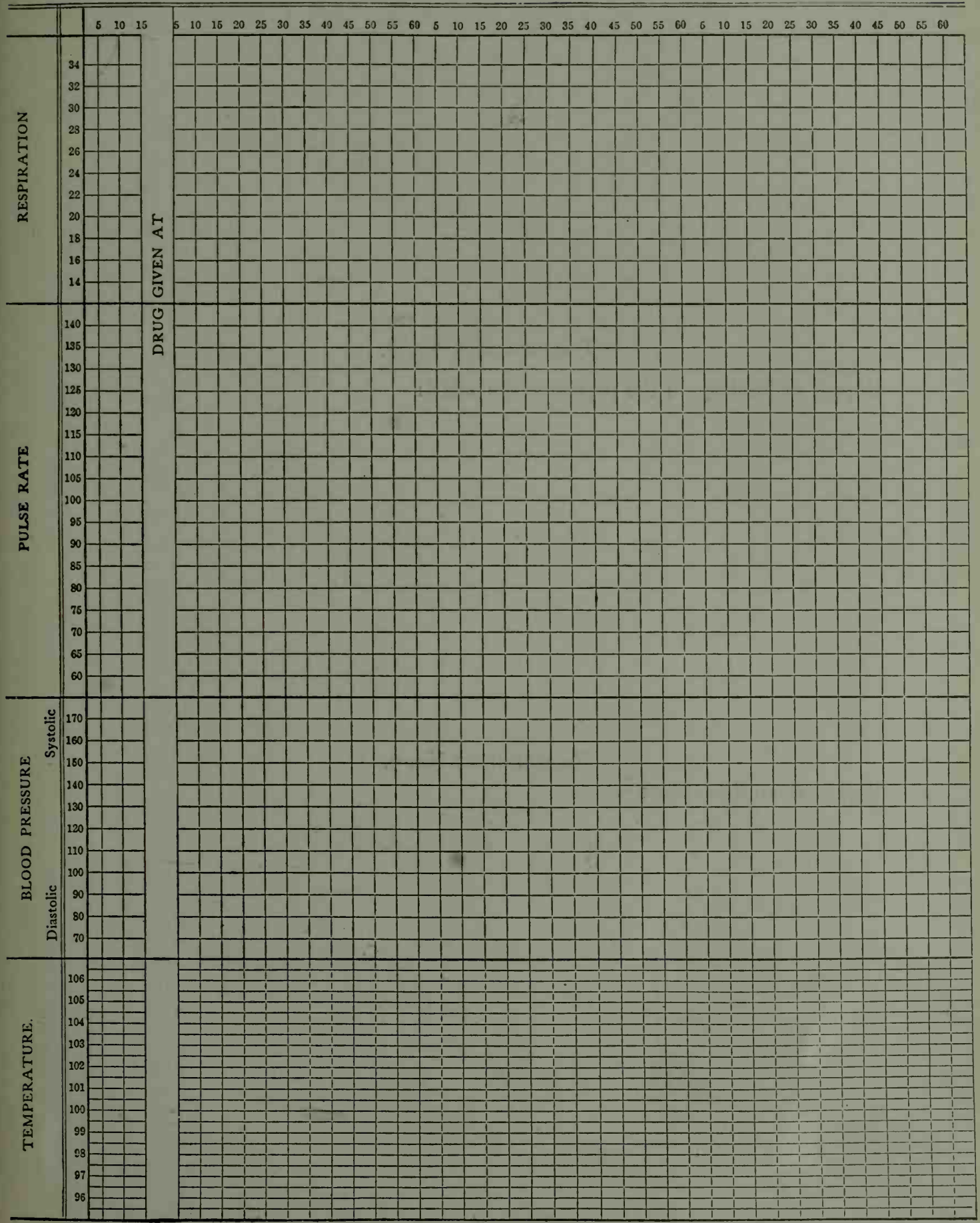
.....

.....

.....

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



EXPERIMENT No. 7.

Report of findings at the hospital:

EXPERIMENT No. 8.

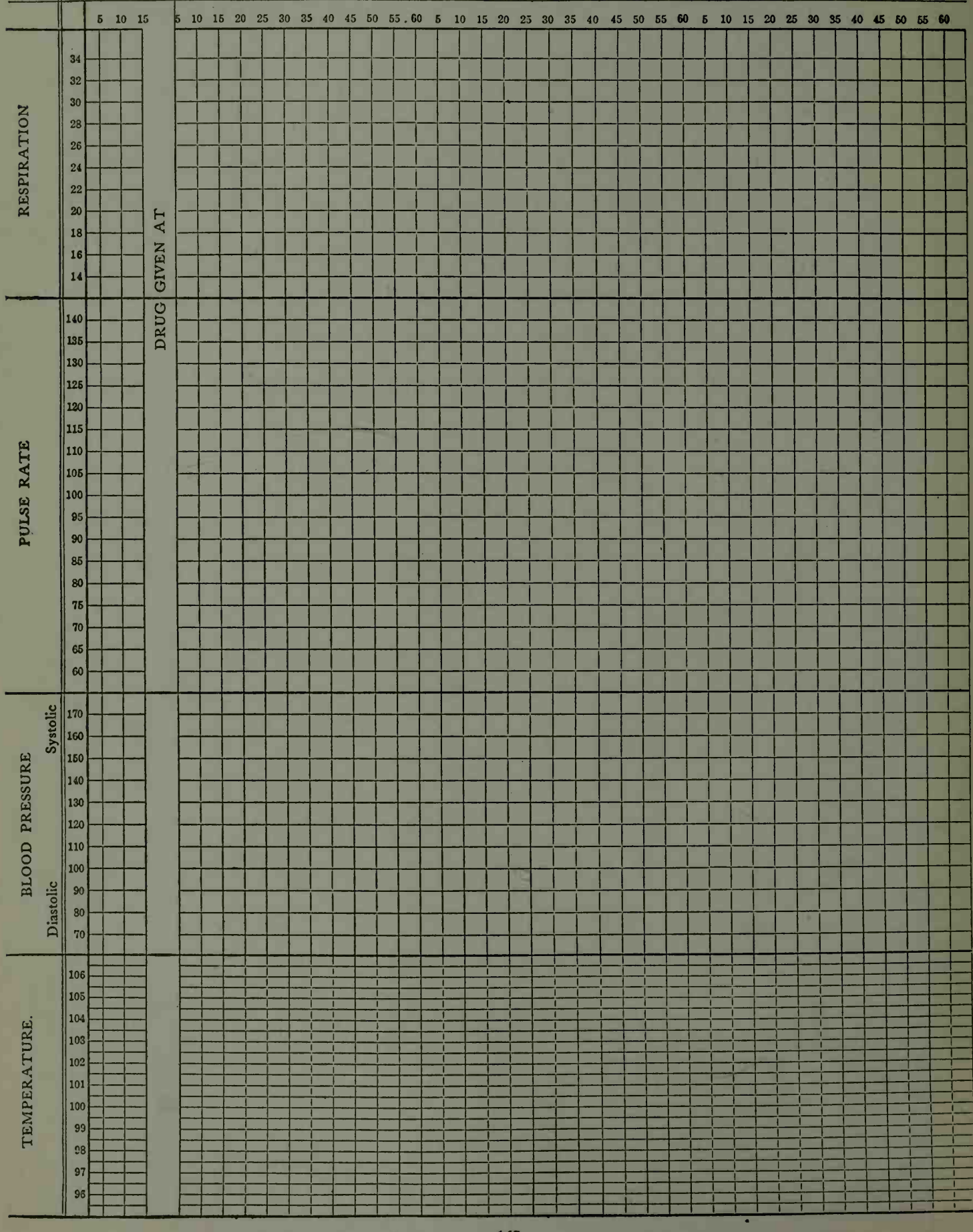
Report of findings in the psychopathic ward:

EXPERIMENT No. 9.

Report from literature:

Subject's initials or No. .....
Age ..... Sex ..... Height ..... Weight .....
Condition .....
Thermometer .....
Barometer .....
Relative humidity .....

Date .....
Medicine .....
Dose .....
How administered .....
Remarks .....
Reporter .....



Subject's initials or No. ..... Date .....

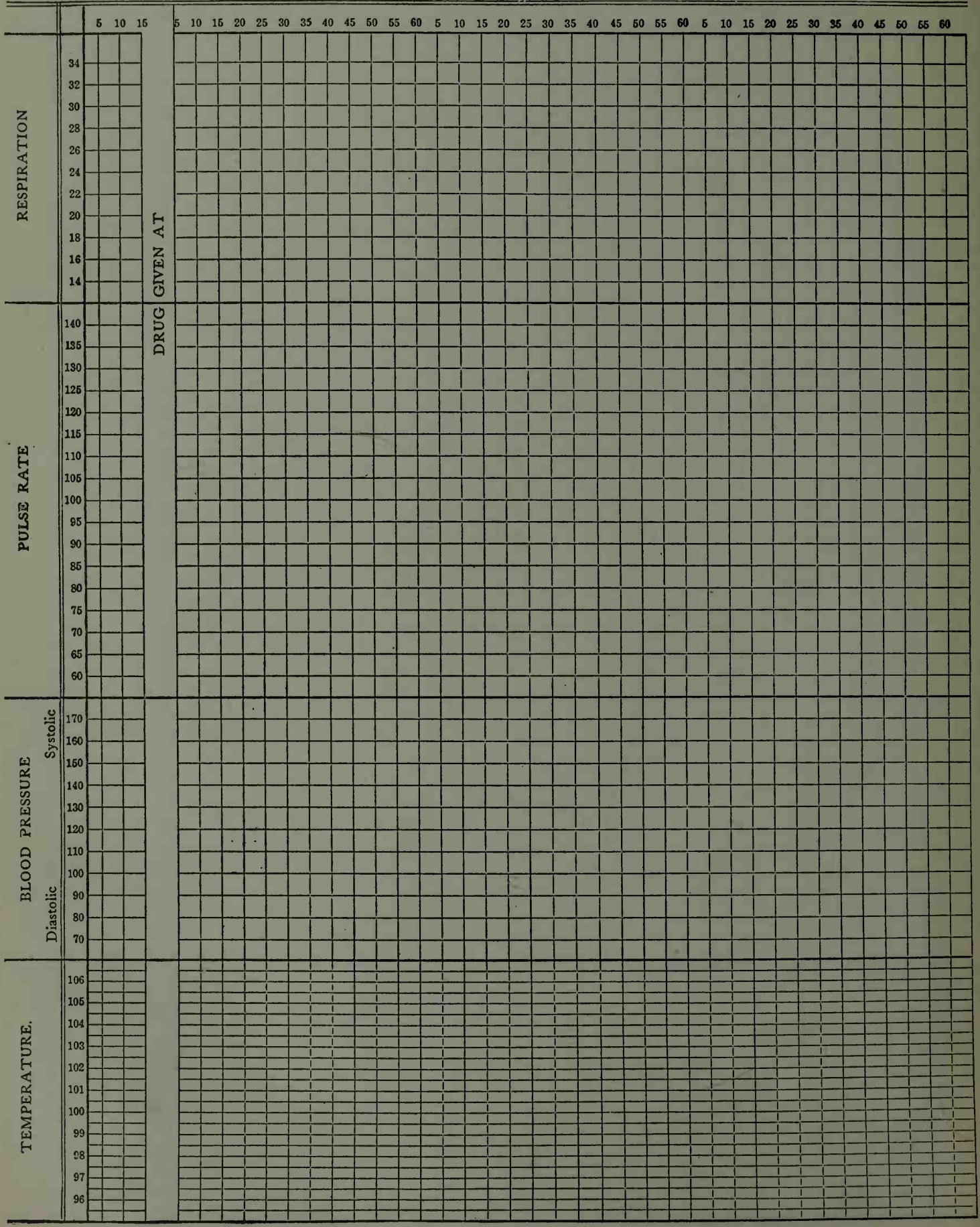
Age ..... Sex ..... Height ..... Weight ..... Medicine .....

Condition ..... Dose .....

Thermometer ..... How administered .....

Barometer ..... Remarks .....

Relative humidity ..... Reporter .....



Subject's initials or No. _____ Date _____

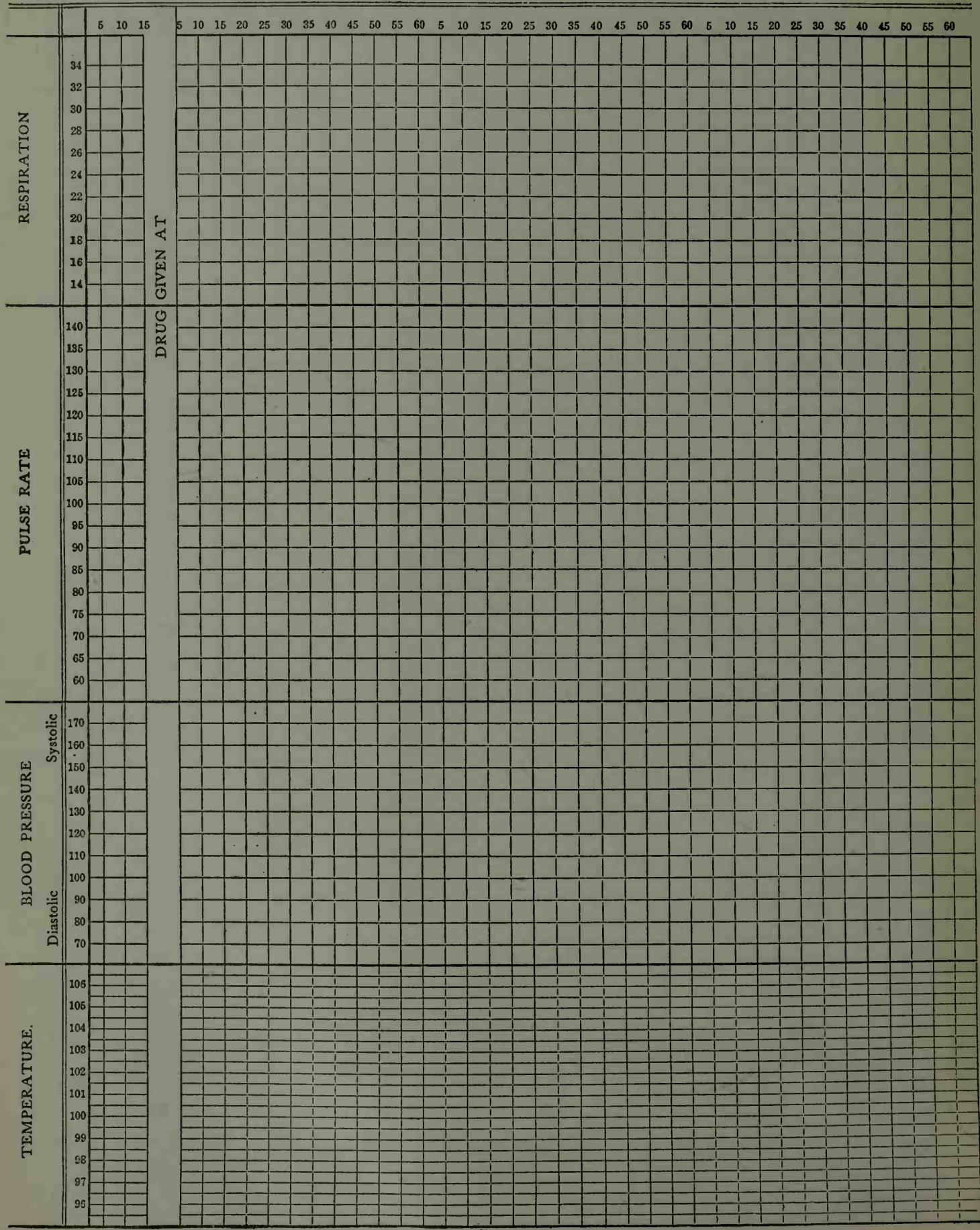
Age _____ Sex _____ Height _____ Weight _____ Medicine _____

Condition _____ Dose _____

Thermometer _____ How administered _____

Barometer _____ Remarks _____

Relative humidity _____ Reporter _____

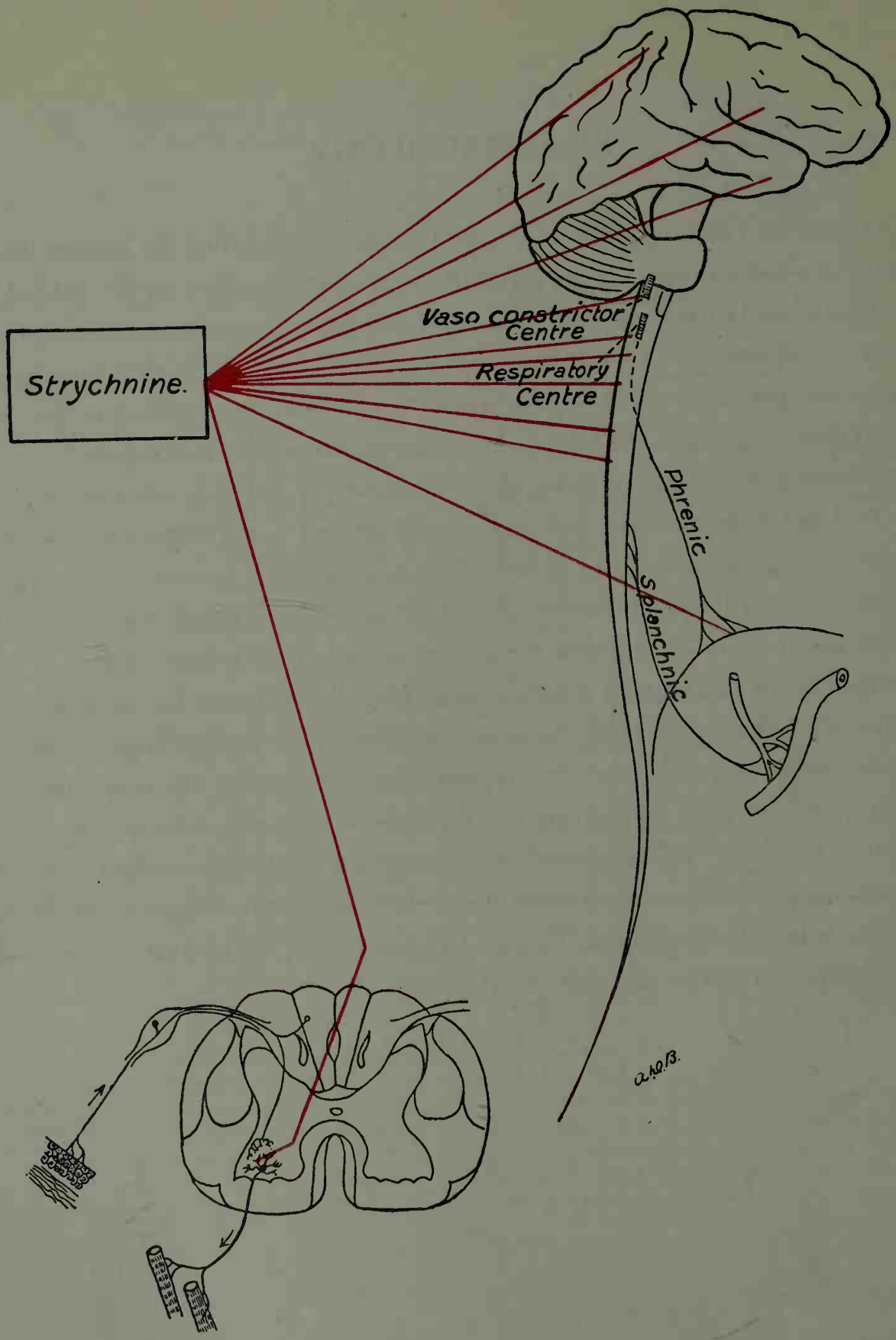


PHARMACOLOGY.

THIS section has been written for the purpose of presenting the leading data of Pharmacology in a compact, concise form. In the average text-book on any subject, the essential facts are not infrequently submerged in a sea of speculation, discussion, and rehearsal of evidence, all of which has its great value, especially for the weighing of mooted points; but there are also times when the immediate determining of the essential fact is more important. For those times this section will prove valuable.

This section is to be used as an aid to one's work—not as a substitute for that work. It is not to be assumed that any earnest student would delude and cheat himself by presenting this data in lieu of that of his own delving. On the contrary, he will use the information thus conveniently placed at hand for correctly orienting himself when confronted with difficulties, or for adding to his sum of information.

Readers of the literature of Pharmacology must be impressed by the lack of uniformity among writers concerning the pharmacodynamics of various drugs. Such disagreements arise from the diversity of conditions surrounding the experimentation with drugs, and therefore demand that in this science, as in all others, our conclusions must be tentative only. In the meanwhile, we must pin our faith somewhere, selecting such conclusions as seem warranted by the present weight of evidence. The faith of this Manual is largely founded on "Cushny's Pharmacology," with such minor modifications as seem justified by personal experience.



Crimson = stimulation.

PART IV.—PHARMACOLOGY.

STRYCHNINE.

Strychnine ($C_{21}H_{22}N_2O_2 = 331.73$) is an alkaloid derived from the dried ripe seed of *Strychnos Nux Vomica,* a tree indigenous to southeastern Asia.

Pharmacodynamics.

Central Nervous System.—Strychnine remarkably heightens synaptic conductivity in the anterior columns of the spinal cord, extending motor response and disrupting normal co-ordinating influences. It also greatly intensifies sensory irritability. It increases cerebral reflexes, especially those of the special senses.

Muscular System.—Strychnine has no direct action on voluntary muscle, but indirectly stimulates involuntary muscle.

Respiration.—Strychnine slightly quickens and deepens respiration, when administered in small doses. Poisonous doses produce asphyxia by spasm of the respiratory muscles.

Heart is not affected directly.

Blood-pressure.—Strychnine stimulates the vasomotor centers, raising slightly the blood-pressure through constrictor action in the splanchnic area, which is not offset by the peripheral dilatation.

Alimentary Tract.—Strychnine stimulates the flow of saliva.

Metabolism.—Oxidation is augmented by strychnine.

Temperature is slightly increased from the advanced oxidation.

Absorption takes place rapidly from the alimentary tract and from the subcutaneous tissues.

Excretion is mainly *via* kidneys, and is much prolonged (2 to 8 days), though the greater part is eliminated in a few hours.

Tolerance is not acquirable; in fact, susceptibility to strychnine action seems to increase with its use.

Symptoms.

Therapeutic Doses.	*Poisonous Doses.*
Improved appetite.	Tense muscles of face and neck.
Cheerfulness.	Heightened reflex irritability.
Accentuated color-sense.	Restlessness.
Extended field of vision.	Involuntary tremors.
Sharpened sense of hearing.	Convulsive movements.
More delicate tactility.	Risus sardonicus.
	Facial cyanosis.
	Opisthotonus.
	Asphyxia and exhaustion.

Therapeutics.

The principal indication for Strychnine is as a stimulant for the central nervous system.

Dosage.

Strychnina, 0.0006 to 0.002 Gm.
Strychninæ Sulphas, 0.0006 to 0.002 Gm.
Tinctura Nucis Vomicæ, 0.3 to 1.2 mil.

CAFFEINE.

Caffeine ($C_5H(CH_3)_3N_4O_2 . H_2O = 210.64$) is a feebly basic substance derived from the berries of *Coffea Arabica* and from the dried leaves of *Thea Chinensis*.

Pharmacodynamics.

Central Nervous System.—Caffeine stimulates the entire system, but especially the higher psychical functions. This effect is much more marked when a previous depression exists.

Muscular System.—Irritatively stimulated.

Respiration is increased and strengthened; centric action.

Heart rate may be increased for short period from local irritation; then later may be slowed from centric inhibition.

Blood-pressure may be increased slightly by centric vasoconstrictor action.

Alimentary tract may be irritated by habitual use of caffeine.

Secretory Glands.—Caffeine stimulates the secretory epithelium of the kidney, and increases circulation through the renal vessels.

Metabolism is moderately stimulated.

Temperature is elevated by centric action, with big doses only.

Absorption is fairly rapid from gastro-intestinal tract.

Excretion.—Caffeine is eliminated in the urine, chiefly, in the form of urea and some xanthin compounds.

Tolerance may be attained to some degree.

Symptoms.

Moderate Doses.	*Large Doses.*
Heightened mentality, sensory side.	Ringing in the ears.
Diminished mentality, motor side.	Sense of cerebral pressure.
Restlessness and insomnia.	Confusion of thought.
Augmented physical ability.	Great restlessness.
Heightened sense of touch.	Exaggerated spinal reflexes.
Increased pulse rate (by 6 to 8).	

Symptoms arising from *chronic Caffeinism:*

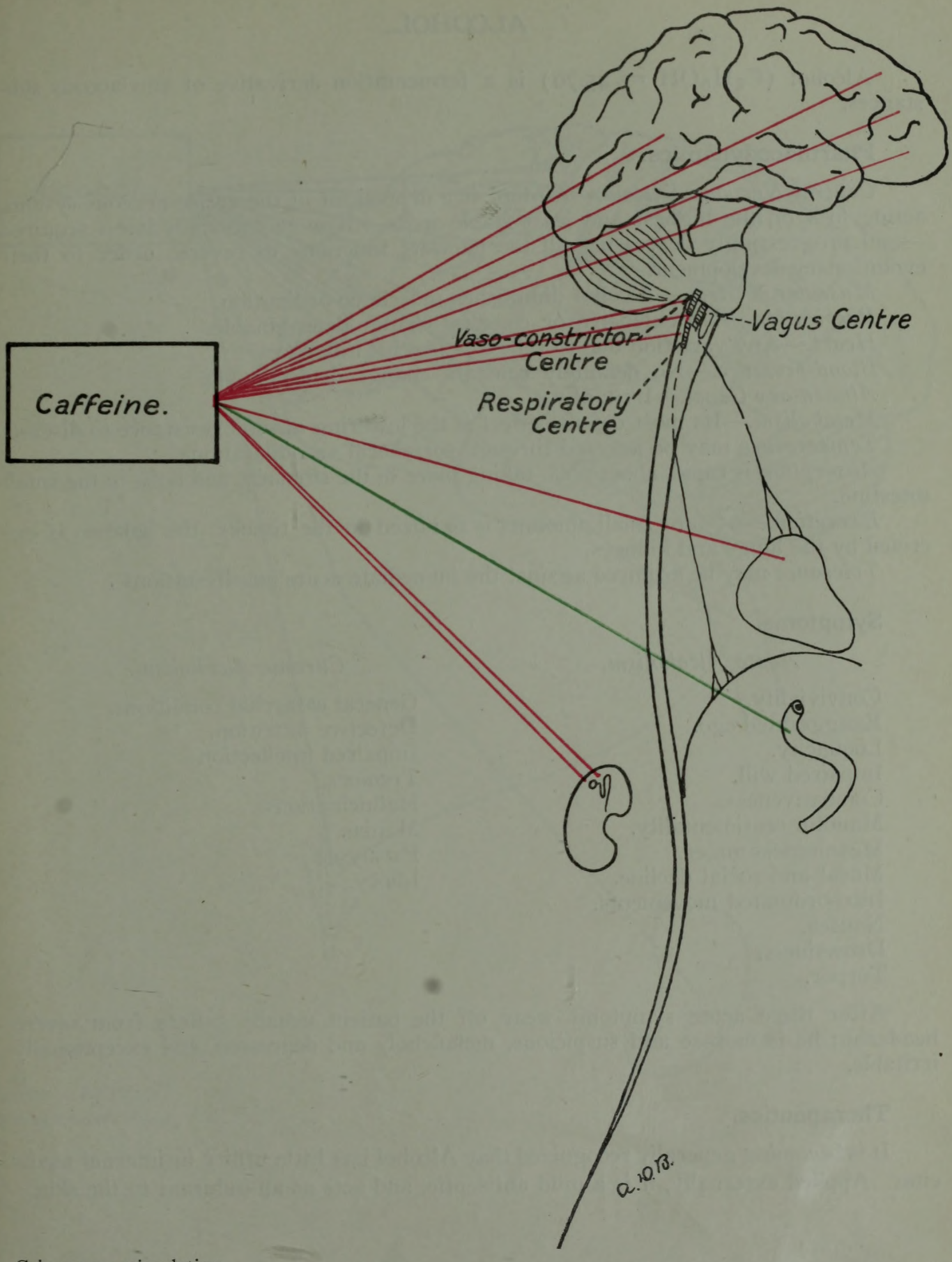
Nervousness.	Moodiness.
Cardiac irregularities.	Alternations of optimism and despondency.
Headache and insomnia.	Lassitude and indisposition.
Irritability.	

Therapeutics.

Caffeine may be used advantageously as a respiratory stimulant, to combat depressed conditions of the nervous system, and as a diuretic in dropsical conditions.

Dosage.

Caffeina, 0.03 to 0.15 Gm.
Caffeina citrata, 0.06 to 0.3 Gm.



Crimson = stimulation.
Green = irritation.

ALCOHOL.

Alcohol ($C_2H_5OH = 45.70$) is a fermentation derivative of amylaceous substances.

Pharmacodynamics.

Central Nervous System.—Alcohol is a depressant of the entire nervous system, acting first on the highest and least stable areas—those evolutionally latest acquired—and progressingly depressing all the nervous functions in reverse order to their evolutionary development.

Muscular System.—Alcohol diminishes muscle co-ordination.

Respiration.—No extensive or constant change determinable.

Heart.—Any variation due to reflex or psychic influences.

Blood-pressure.—No definitely constant change determinable.

Alimentary Canal.—Irritant.

Metabolism.—Its most definite effect is the lowering of vital resistance to disease.

Temperature may be lowered through peripheral vasodilatation.

Absorption is rapid, about 20% taking place in the stomach, and 80% in the small intestine.

Excretion.—95% of small amounts is oxidized in the tissues; the balance is excreted by the lungs and kidneys.

Tolerance may be acquired against the immediate acute manifestations.

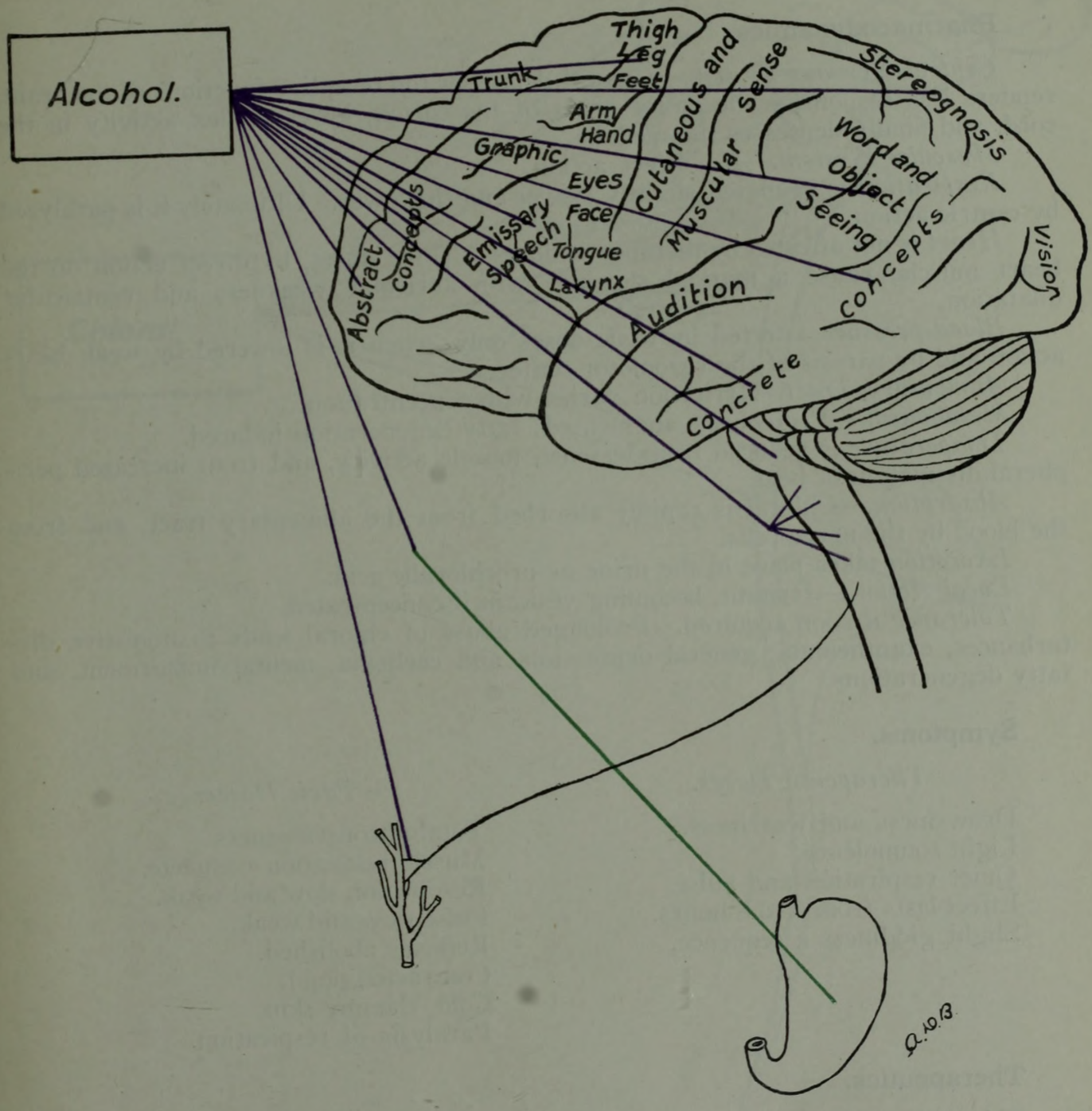
Symptoms.

Acute Alcoholism.	*Chronic Alcoholism.*
Conviviality.	General catarrhal conditions.
Exaggerated ego.	Defective nutrition.
Loquacity.	Impaired intellection
Impaired will.	Tremors.
Combativeness.	Hallucinations.
Maudlin sentimentality.	Manias.
Meaningless anger.	Paralyses.
Moral and social decline.	Idiocy.
Inco-ordinated movements.	
Nausea.	
Drowsiness.	
Torpor.	

After these acute symptoms wear off the patient usually suffers from severe headache; he is morose and suspicious, melancholy and depressed, and exceptionally irritable.

Therapeutics.

It is becoming generally recognized that Alcohol has little utility in internal medicine. Applied externally, it is a mild antiseptic, and acts as an indurant to the skin.



Green = irritation.
Violet = depression.

CHLORAL HYDRATE.

Chloral, or trichloraldehyde ($C_2HCl_3O + H_2O = 164.12$), is obtained by treating absolute alcohol with chlorine.

Pharmacodynamics.

Central Nervous System.—Chloral depresses the receptive functions of the brain, renders less responsive the motor areas of the cortex, lowers reflex activity in the cord, and finally depresses the medulla.

Muscular System.—No direct action.

Respiration is rendered slightly slower and shallower. Ultimately it is paralyzed by centric action.

Heart is not affected by therapeutic doses. Toxic doses, by direct action on the heart muscle, cause a marked slowing, with auricular weakness and ventricular dilatation.

Blood-pressure affected by toxic doses only, when it is lowered by weak heart action and by paresis of the vasomotor center.

Alimentary Tract.—Irritation varies with concentration.

Metabolism.—Proteolysis augmented; fatty degeneration induced.

Temperature is reduced from lessened muscle activity, and from increased peripheral dissipation of heat.

Absorption.—Chloral is rapidly absorbed from the alimentary tract, and from the blood by the nerve cells.

Excretion takes place in the urine as urochloralic acid.

Local Action.—Irritant, becoming vesicant if concentrated.

Tolerance is soon acquired. Prolonged abuse of chloral leads to digestive disturbances, exanthemata, general depression, and cachexia, mental impairment, and fatty degenerations.

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Drowsiness and weariness.	Total unconsciousness.
Light somnolence.	Muscle relaxation complete.
Quiet respiration and pulse.	Respiration slow and weak.
Effect lasts from 6 to 8 hours.	Pulse slow and weak.
Slight giddiness a sequence.	Reflexes abolished.
	Contracted pupil.
	Cold, clammy skin.
	Paralysis of respiration.

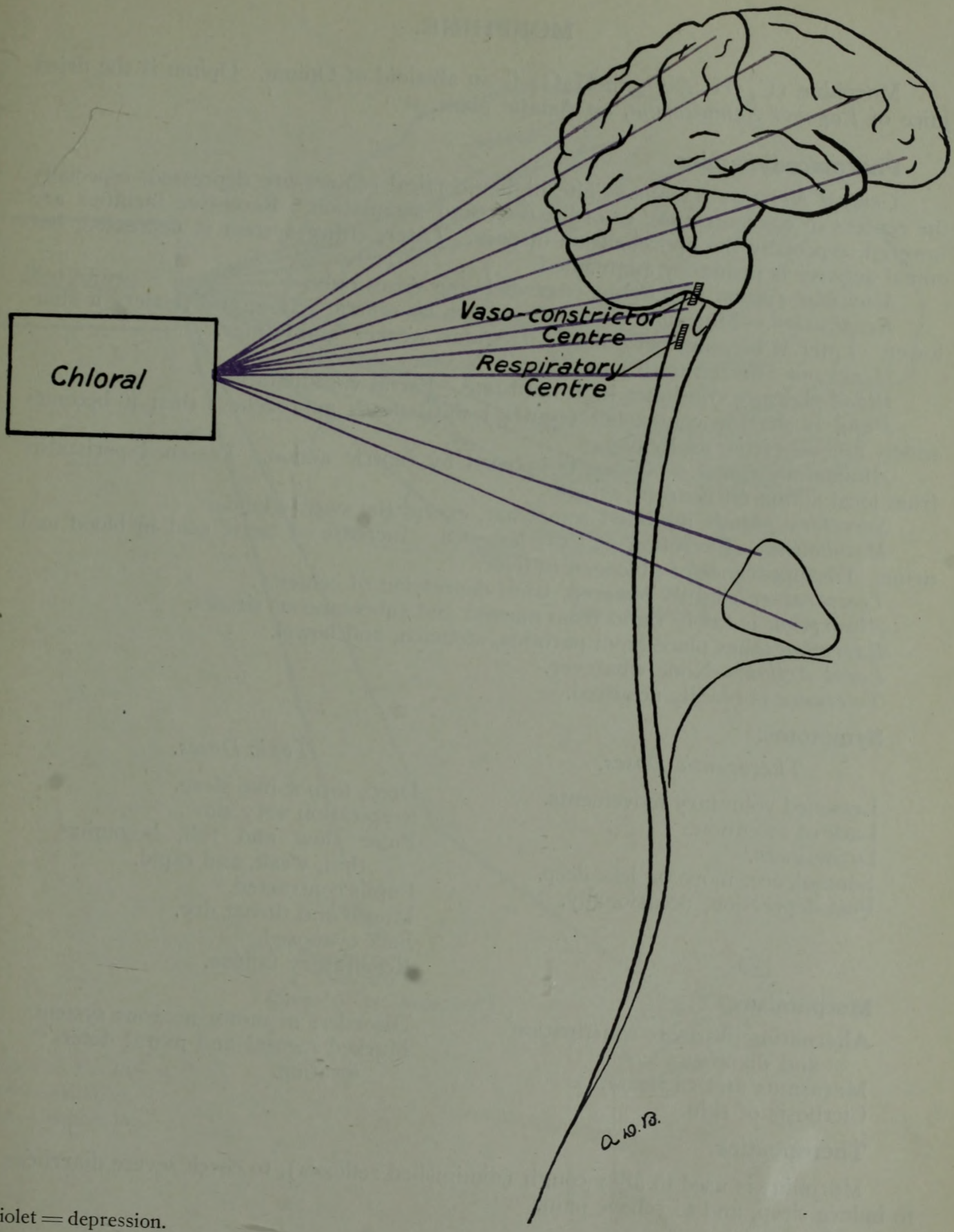
Therapeutics.

Chloral is used to quiet nervous excitement, to induce sleep, and to relieve convulsions. Not an analgesic.

Dosage.

0.3 to 2 Gm., freely diluted.

Sulphonethylmethane and Sulphonmethane may be used in place of Chloral. They are attended with some danger, but show less after-depression, and usually produce as refreshing a sleep. Dose of either, 0.6 to 2 Gm.



Violet = depression.

MORPHINE.

Morphine ($C_{17}H_{19}NO_3 + H_2O$) is an alkaloid of Opium. Opium is the dried juice of *Papaver Somniferum*, an Asiatic plant.

Pharmacodynamics.

Central Nervous System.—The higher cortical centers are depressed, especially the centers of concentration, co-ordination, and summation. Receptive faculties are lowered, especially the apprehension of pain. Later, entire system is depressed, but spinal activity is primarily augmented.

Muscular system affected by overwhelming doses only.

Respiration.—Morphine slows respiration by centric action, and renders it shallower. Later it becomes periodically irregular, weaker, and fainter.

Heart not affected until late, when it becomes slowed.

Blood-pressure continues high until late. Facial vasodilatation.

Pupil is sharply contracted (centric) until death approaches; then it becomes widely dilated (from asphyxia).

Alimentary Canal.—Nausea is induced by centric action. Lessened peristalsis from local action on neurons.

Secretory glands inhibited somewhat, except the sweat-glands.

Metabolism.—Excretion of CO_2 lessened. Increase of lactic acid in blood and urine. Disappearance of glycogen in liver.

Temperature slightly lowered, from depression of center.

Absorption is fairly rapid from mucosa and subcutaneous tissues.

Excretion takes place from parotids, stomach, and bowel.

Local Action.—None whatever.

Tolerance is readily acquired.

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Lessened voluntary movements.	Deep, torpor-like sleep.
Lack of attention.	Respiration very slow.
Drowsiness.	Pulse slow and full, becoming thin, weak, and rapid.
Somnolence, more or less deep.	Pupils contracted.
Post-depression, occasionally.	Mouth and throat dry.
	Face cyanosed.
	Respiratory failure.

Morphinism.

Alternating obstinate constipation and diarrhea.	Disorders of motor-nervous system.
Marasmus and cachexia.	Marked mental and moral deterioration.
Cirrhosis of skin.	

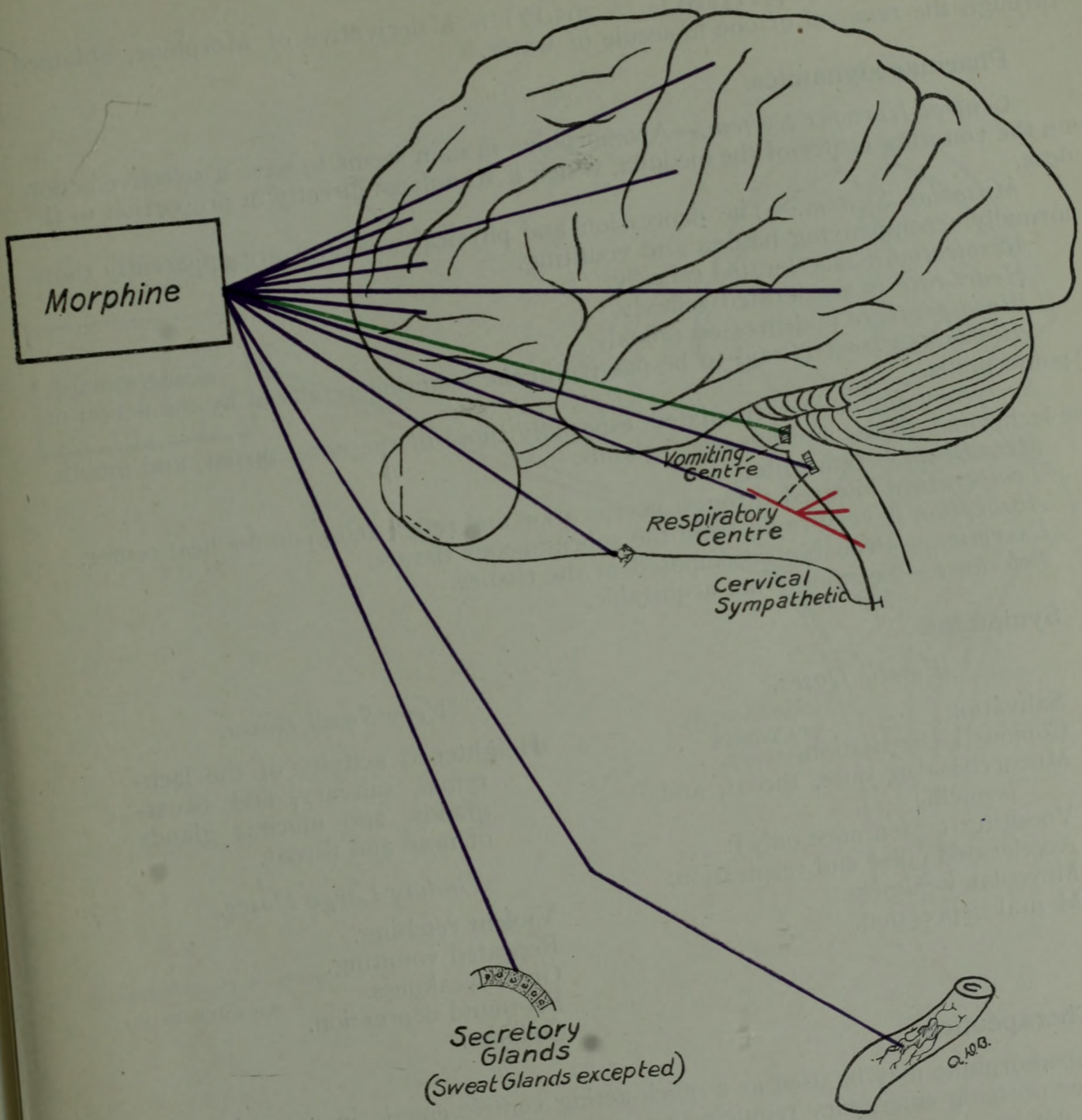
Therapeutics.

Morphine is used to allay cough (diminished reflexes), to check severe diarrheas, to induce sleep, and to relieve pain.

Dosage.

0.008 to 0.016 Gm.

The action of Codeine is similar to that of Morphine, though to a much less degree.
Dose: 0.015 to 0.08 Gm.



Crimson = stimulation.
Green = irritation.
Violet = depression.

APOMORPHINE.

Apomorphine ($C_{17}H_{17}NO_2 = 265.17$) is a derivative of Morphine, obtained through the removal of one molecule of water.

Pharmacodynamics.

Central Nervous System.—Apomorphine in man seems to have a selective action on the vomiting center of the medulla, which it stimulates directly in proportion to the dose.

Muscular System.—The depression and physical weakness are apparently those normally accompanying nausea and vomiting.

Respiration is accelerated reflexly.

Heart-rate is accelerated reflexly.

Blood-pressure is depressed reflexly.

Alimentary tract is said to be passive in the vomiting produced by the action of Apomorphine.

Secretory glands are stimulated, especially those of the nose, throat, and mouth, the lachrymal glands and the sweat-glands.

Metabolism.—Indefinite.

Temperature lowered through perspiration and reflex action on the heat center.

Absorption is very rapid from the subcutaneous tissues.

Excretion.—Probably decomposed in the tissues.

Tolerance.—Seemingly not acquirable.

Symptoms.

Emetic Doses.

Salivation.
Copious lachrymation.
Mucorrheas of nose, throat, and bronchi.
Vomiting (often once only).
Accelerated pulse and respiration.
Muscular weakness.
Mental depression.

Very Small Doses.

Heightened activity of the lachrymal, salivary, and sweat-glands, and mucous glands of nose and throat.

Unduly Large Doses.

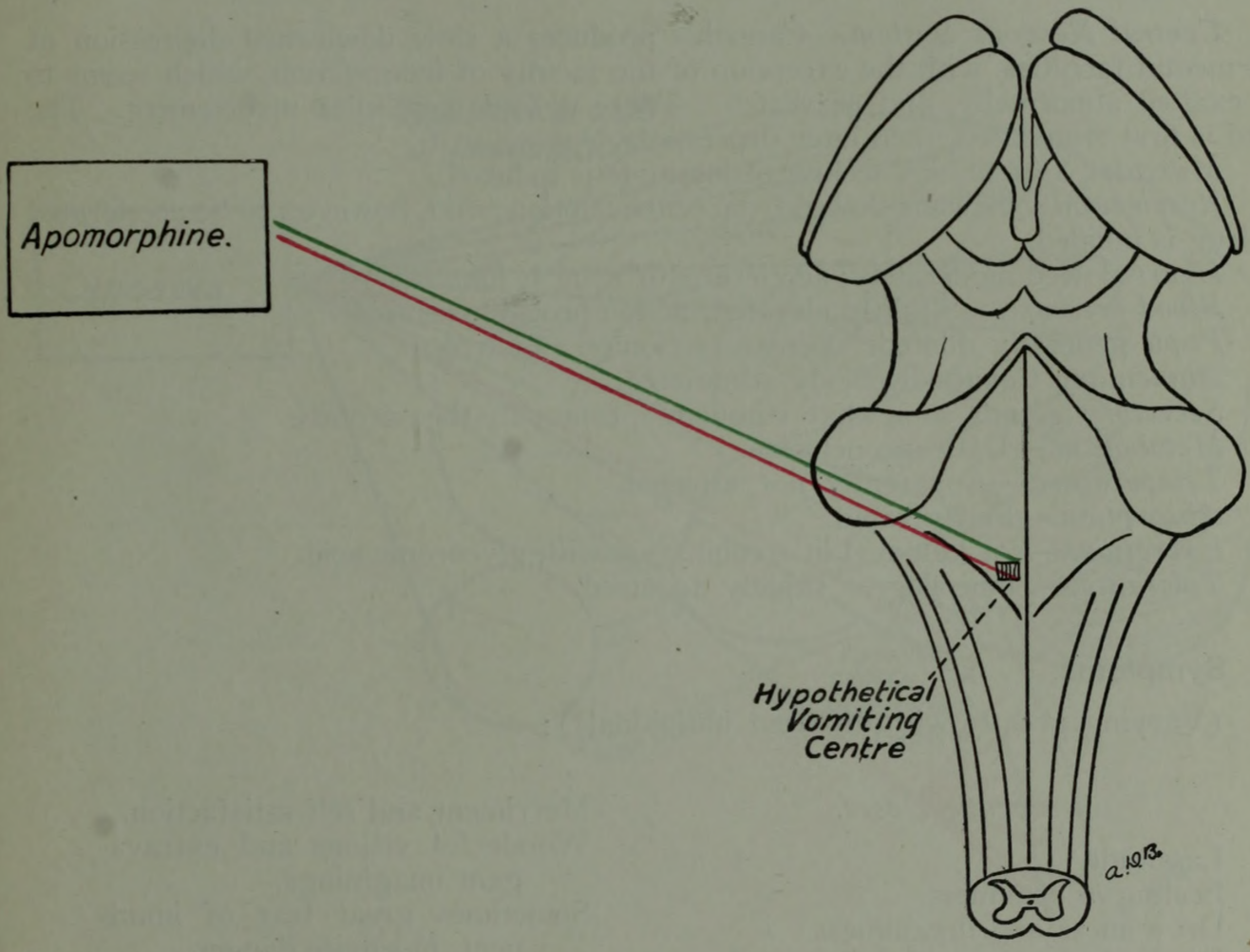
Violent retching.
Repeated vomiting.
Great weakness.
Profound depression.
Collapse.

Therapeutics.

Apomorphine may be used as a quick-acting centric emetic in case of poisoning or other pressing emergency requiring prompt evacuation of the stomach contents. It should not be given to children or to debilitated patients.

Dosage.

Expectorant, about 0.002 Gm.
Emetic, about 0.005 Gm.



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Green = irritation.

CANNABIS

Cannabis is obtained from the flowering tops of *Cannabis Sativa,* or Indian Hemp, a sub-tropical plant. It owes its activity to a red oil, cannabinol, a phenolaldehyde with the composition $OH.C_{20}H_{28}COH$.

Pharmacodynamics.

Central Nervous System.—Cannabis produces a slow downward depression of the mental faculties, with the exception of the faculty of imagination, which seems to be exalted abnormally, and perverted. There is some cerebellar involvement. The cord is first stimulated, then later depressed.

Muscular System.—A feeling of lassitude is induced.

Respiration somewhat slowed from centric action; said, however, to be accelerated if drug is inhaled.

Heart slowed moderately; accelerated if drug is inhaled.

Blood-pressure.—Slightly elevated, action probably centric.

Pupil generally dilated. Centric action on motor oculi.

Alimentary Canal.—Reflexly stimulated.

Secretory glands somewhat stimulated, especially the parotids.

Metabolism.—Data inconclusive.

Temperature.—Apparently not affected.

Absorption.—Fairly rapid.

Excretion.—Via kidneys, in combination with glycuronic acid.

Tolerance.—Some degree rapidly acquired.

Symptoms.

(Varying greatly with different individuals):

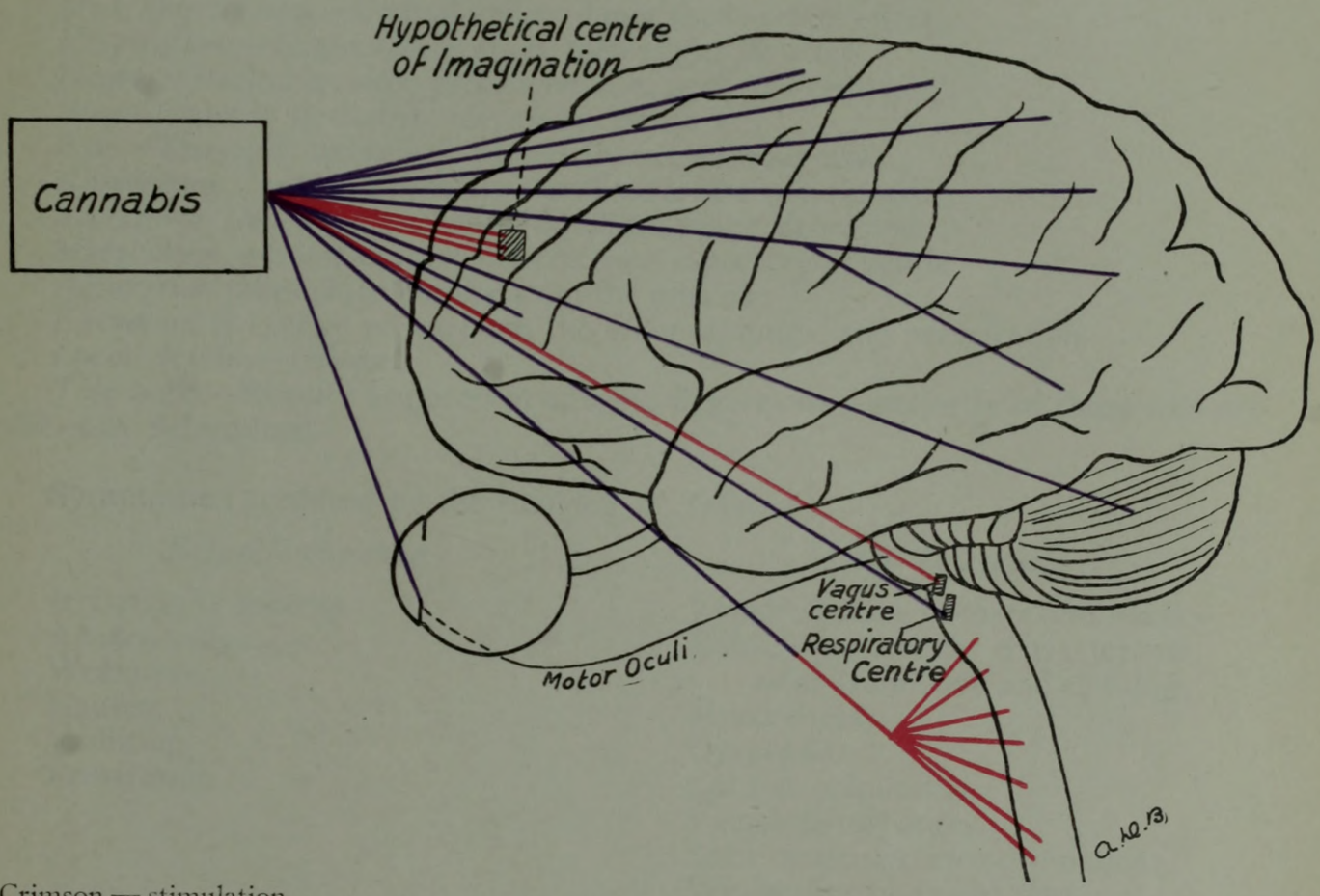
Therapeutic Doses.

Lassitude.
Feeling of heaviness.
Drowsiness and dreaminess.
Diminished sense of touch and pain.
Distorted ideas of time and space, mere fractions seeming vast.
Merriment and self-satisfaction.
Wonderful visions and extravagant imaginings.
Sometimes great fear of imminent, indefinite danger.
Partial or recurrent unconsciousness.
Deep tranquil sleep.

Cannabis may occasionally be advantageously employed in cases of insomnia due to nervousness or nervous exhaustion.

Dosage.

Extractum Cannabis 0.01 to 0.03 Gm.
Fluidextractum Cannabis, 0.06 to 0.2 mil.
Tinctura Cannabis 0.6 to 2 mils.



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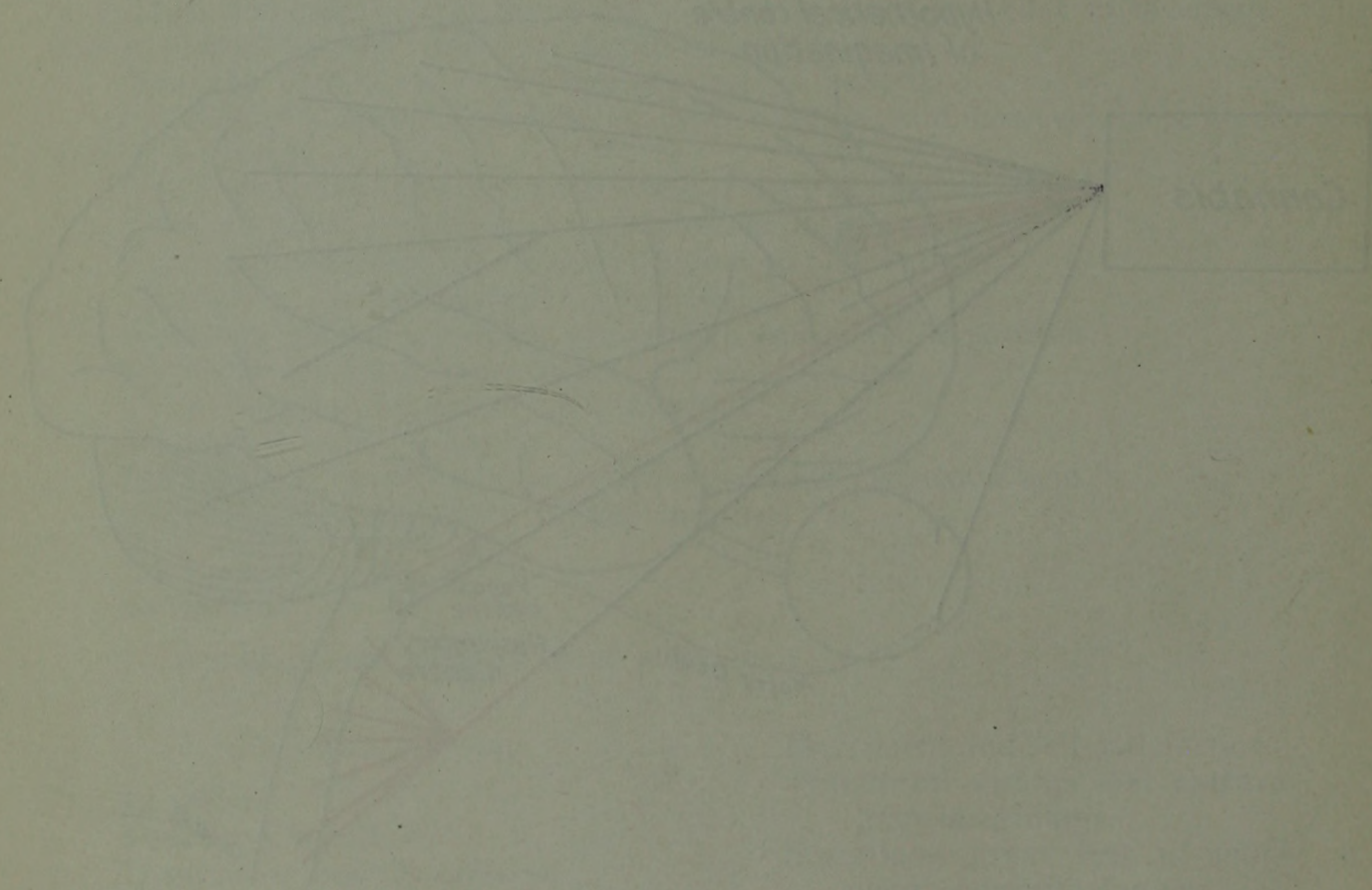


NICOTINE.

Nicotine ($C_{14}H_{10}N_2 = 160.96$) is the principal alkaloid of *Nicotiana tabaccum*. It is decomposed, during the combustion of tobacco in smoking, into pyridine and other pyrrol products.* The toxicity of Nicotine to pyridine is in the ratio of 22 to 1.

Pharmacodynamics (of Tobacco when smoked).

Central Nervous System.—Higher centers are depressed; lower centers and cord are first irritated, then depressed.
Muscular System.—Actual ability diminished; reflex effect.
Respiration.—Slight acceleration, then slight slowing.
Heart.—Irregular after prolonged use; probably centric.
Blood-pressure is slightly elevated; centric (?)
Eye.—The optic nerve is irritated from continued use.
Alimentary Canal.—Primarily stimulated; later depressed.
Secretory Glands.—Primarily stimulated; later depressed.
Metabolism.—Some obscure interference, especially in youth.
Absorption takes place readily from the mucosa.
Excretion is carried on through the kidneys, lungs, and perspiration.
Local Action.—Irritant.
Tolerance.—Readily acquired in varying degrees by a majority of those who are sufficiently determined.

Symptoms. (produced by the smoking of Tobacco).

Before Tolerance.	*After Tolerance.*
Irritation of mucosa.	Impaired sense of taste and smell.
Altered vision.	Rank, persistent characteristic odor from body and clothing.
Weakness.	Mucorrheas.
Nausea.	Dyspepsias.
Vomiting.	Cardiac palpitation.
Prostration.	Visual disturbances.
	Some muscular inco-ordinations.
	Weakening of moral fiber.
	Relative enfeeblement of will.
	Diminished sense of personal responsibility.
	Lowered mental capability.

Therapeutics.

Nicotine and Tobacco have no place whatever in applied medicine. Tobacco smoking is an unmixed evil to mankind.

* For experimental evidence on this point, see my article in N. Y. Medical Journal, March 14, 1914: "Tobacco Smoking and Mental Efficiency."

COCAINE.

Cocaine ($C_{17}H_{21}NO_4 = 300.92$) is an alkaloid derived from the leaves of *Erythroxylon coca,* an indigene of South America.

Pharmacodynamics.

Central Nervous System.—Cocaine produces a brief primary descending stimulation, affecting first the cerebrum, then the hind brain, medulla, and cord. The stimulation is succeeded (often accompanied) by marked descending depression.

Muscular System.—Undetermined; possibly increased irritability.

Respiration is accelerated from centric stimulation, becoming progressively shallower and weaker; may show Cheyne-Stokes type.

Heart is accelerated, probably from local stimulation of accelerator fibers.

Blood-pressure is increased from vasoconstrictor stimulation, both centric and peripheral, and by more rapid heart action. Subsequent fall is due to local action on blood-vessels.

Eye.—Pupil is dilated from stimulation of dilator fibers; power of accommodation lessened, also intra-ocular tension.

Alimentary Tract.—Small doses stimulate, large ones inhibit, peristalsis by direct action on local nervous mechanism.

Secretory glands are slightly depressed. Kidneys often stimulated.

Metabolism.—Katabolism thought to be lessened slightly.

Temperature is increased, in poisoning, by action on center.

Absorption is rapid from mucosa and subcutaneous tissues.

Elimination.—Cocaine is largely oxidized in the tissues.

Local Action.—Cocaine produces loss of sensation through paralysis of those sensory nerve terminations that carry impressions of pain and touch. Applied to a nerve it interrupts all sensory impulses.

Tolerance is never more than partially acquired.

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Excitement.	Symptoms of small doses, plus excessive tachycardia, rapid dyspneic breathing, possible convulsions, or fainting and collapse; then cyanosis and cold skin, slow, weak heart; weak, infrequent breathing; death from respiratory failure.
Restlessness and garrulity.	
Accelerated pulse.	
Quickened respiration.	
Dilated pupil.	
Headache and faucial dryness.	
Heightened reflexes.	

Symptoms arising from the *cocaine habit* are: digestive disturbances, emaciation, sleeplessness, tremors, hallucinations, disturbances of sensation and motion, delirium and insanity.

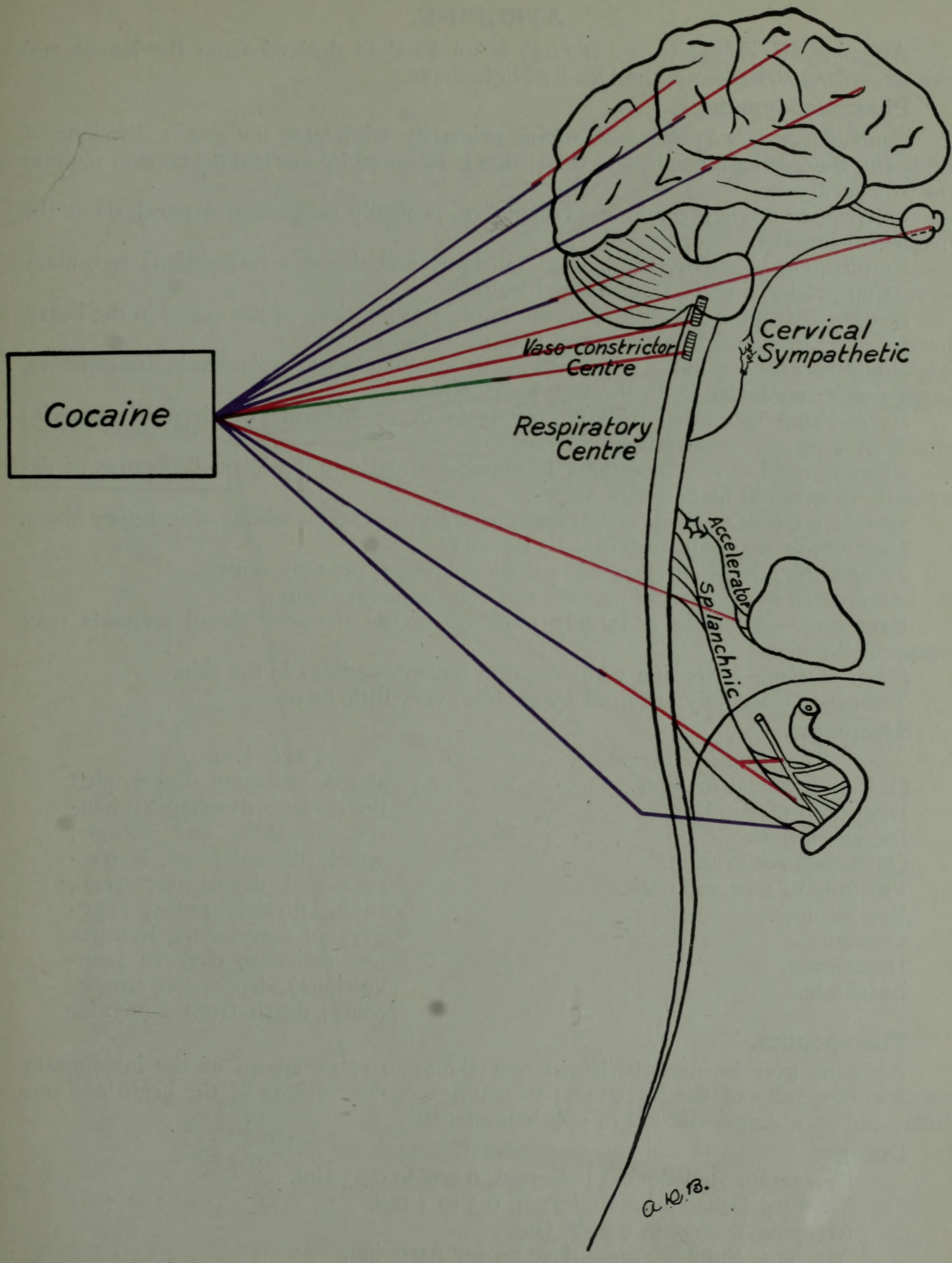
Therapeutics.

Cocaine has its chief utility as a local anæsthetic. Absorption, as thus used, may produce any of the above symptoms in cocaine-sensitive subjects.

Dosage.

Cocaine Hydrochloride, 4% solution for complete anæsthesia; 1% solution for analgesia; 6% solution on mucous membranes; 0.1% solution for infiltration; 1 mil of 2% solution for spinal anæsthesia.

Novocaine is a recently introduced synthetic substitute for Cocaine. It is considerably safer, though more fleeting in action.



Crimson = stimulation.
Green = irritation.
Violet = depression.

ATROPINE.

Atropine ($C_{17}H_{23}NO_3 = 287.04$) is an alkaloid derived from the leaves and root of *Atropa Belladonna*, the Deadly Nightshade.

Pharmacodynamics.

Central Nervous System.—Atropine primarily stimulates the motor divisions of the brain, thence the medulla and cord; this is followed by marked depression tending towards paralysis.

Unstriped muscle is made less responsive, probably because of a paralysis at the myoneural junction.

Respiration.—Centric stimulation quickens and deepens respiration; secondary depression produces slow, shallow breathing.

Heart.—Atropine paralyzes the inhibitory terminations of the vagus in the heart, thereby quickening heart action, and making it less efficient.

Blood-pressure usually rises owing to stimulation of splanchnic constrictors. Large doses may lower B. P. through heart action.

Eye.—Pupil is dilated through paralysis of myoneurals of circularis muscle; muscle of accommodation also paralyzed.

Alimentary Tract.—Secretions lessened, and activity diminished, because of depression of terminal filaments of vagus.

Secretory Glands.—Depressed through paralysis of terminations of secretory fibers.

Metabolism markedly increased (Edsall).

Temperature is often elevated; means unknown; possibly centric.

Absorption is rapid from mucosa and subcutaneous tissues.

Excretion.—Atropine is largely oxidized in the tissues. Small amounts may escape in the urine.

Local Action.—Atropine depresses the sensory endings in the skin.

Tolerance.—Rapidly acquired by rabbits; very little by man.

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Oral and faucial dryness.	Symptoms of small doses plus thirst and dysphagia; nausea, headache and vertigo; widely dilated pupil, hoarseness and dysphonia; weak, rapid, thready pulse; exaggerated movements, hysteria and delirium, tremors (convulsions), depression, stupor, coma; death from asphyxia.
Dilatation of pupil.	
Increased pulse.	
Quickened respiration.	
Flushing of face and neck.	
Restlessness.	
Garrulity.	
Depression.	
Lassitude.	

Therapeutics.

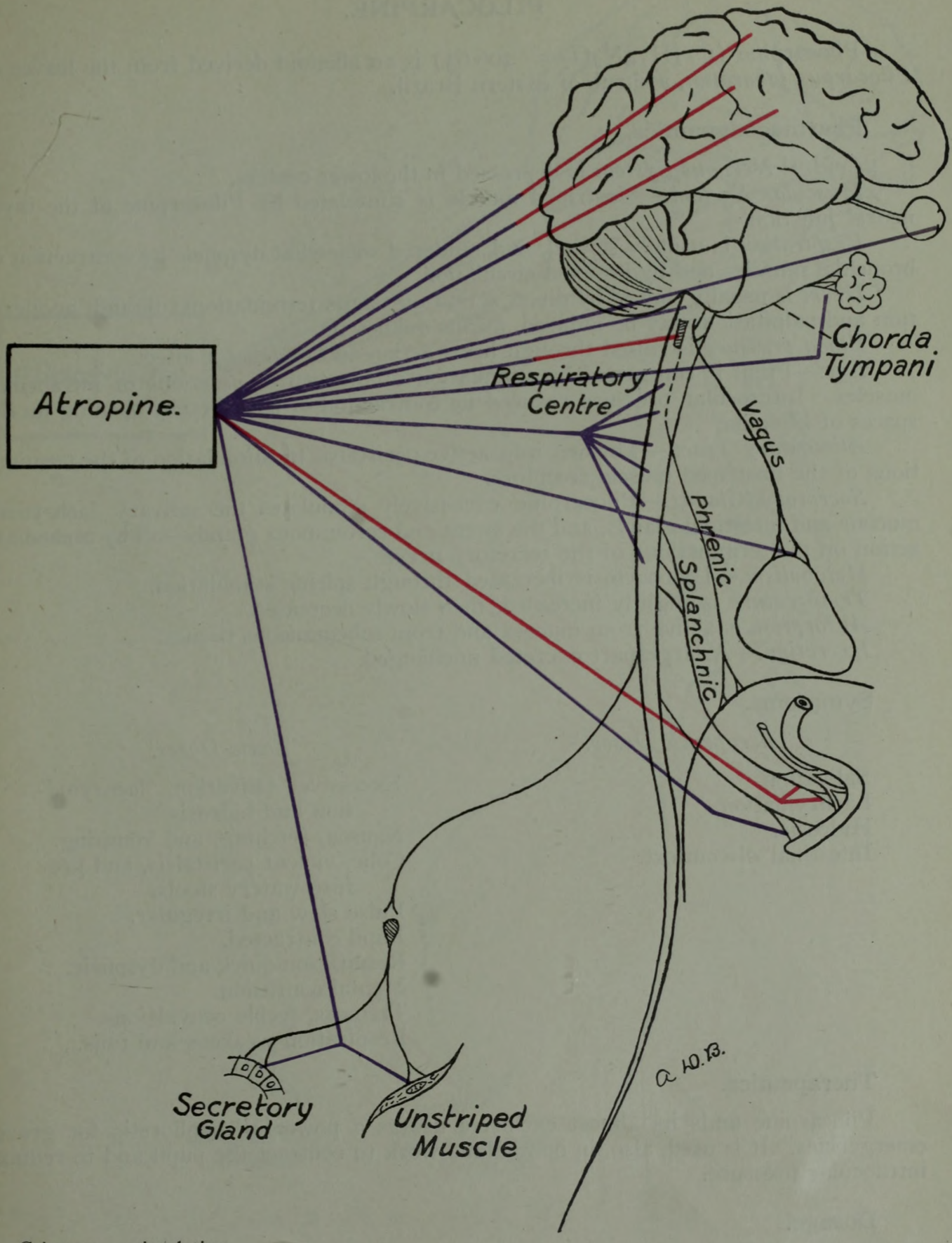
Atropine may be used to lessen secretions; to relax spasm of the involuntary muscles, especially of the intestines; to counteract depressions of the brain and medulla; and as a diagnostic aid to ophthalmologists.

Dosage.

Extractum Belladonnæ Foliorum, 0.005 to 0.03 Gm.
Tinctura Belladonnæ Foliorum, 0.3 to 1 mil.
Atropina, 0.0003 to 0.0008 Gm.
Atropinæ Sulphas, same dose as for Atropina.

Scopolamine, or Hyoscine, resembles closely the action of Atropine, except that it depresses the central nervous system from the start. Hence, it is used in some cases as a hypnotic.

Dosage: Scopolamine Hydrobromide, 0.0003 to 0.0008 Gm.



Crimson = stimulation.
Violet = depression.

PILOCARPINE.

Pilocarpine ($C_{11}H_{16}N_2O_2 = 206.63$) is an alkaloid derived from the leaves of *Pilocarpus jaborandi,* a shrub of eastern Brazil.

Pharmacodynamics.

Central Nervous System is depressed in the lower centers.

Muscular System.—Unstriped muscle is stimulated by Pilocarpine at the myoneural junction.

Respiration is usually slowed, and rendered somewhat dyspneic by contraction of bronchial muscles and by lessened circulation.

Heart is usually slowed by direct action on vagus terminations; though acceleration and palpitation may be induced, means unknown.

Blood-pressure is raised through heart action and vasomotor effect.

Eye.—Pupil is contracted by stimulation of myoneural junctions of intraocular muscles. Intraocular pressure reduced by contraction of iris, thereby opening up the spaces of Fontana.

Alimentary Tract.—Thrown into active peristalsis by stimulation of the terminations of the unstriped muscle receptors.

Secretory Glands.—Pilocarpine excessively stimulates the salivary, lachrymal, mucous and intestinal glands, and the sweat and ceruminous glands—all by immediate action on the terminations of the secretory nerves.

Metabolism.—Leucocytosis increased through splenic stimulation.

Temperature is slightly increased, then slowly decreased.

Absorption is active from mucosa and from subcutaneous tissues.

Excretion.—A large part excreted unchanged.

Symptoms.

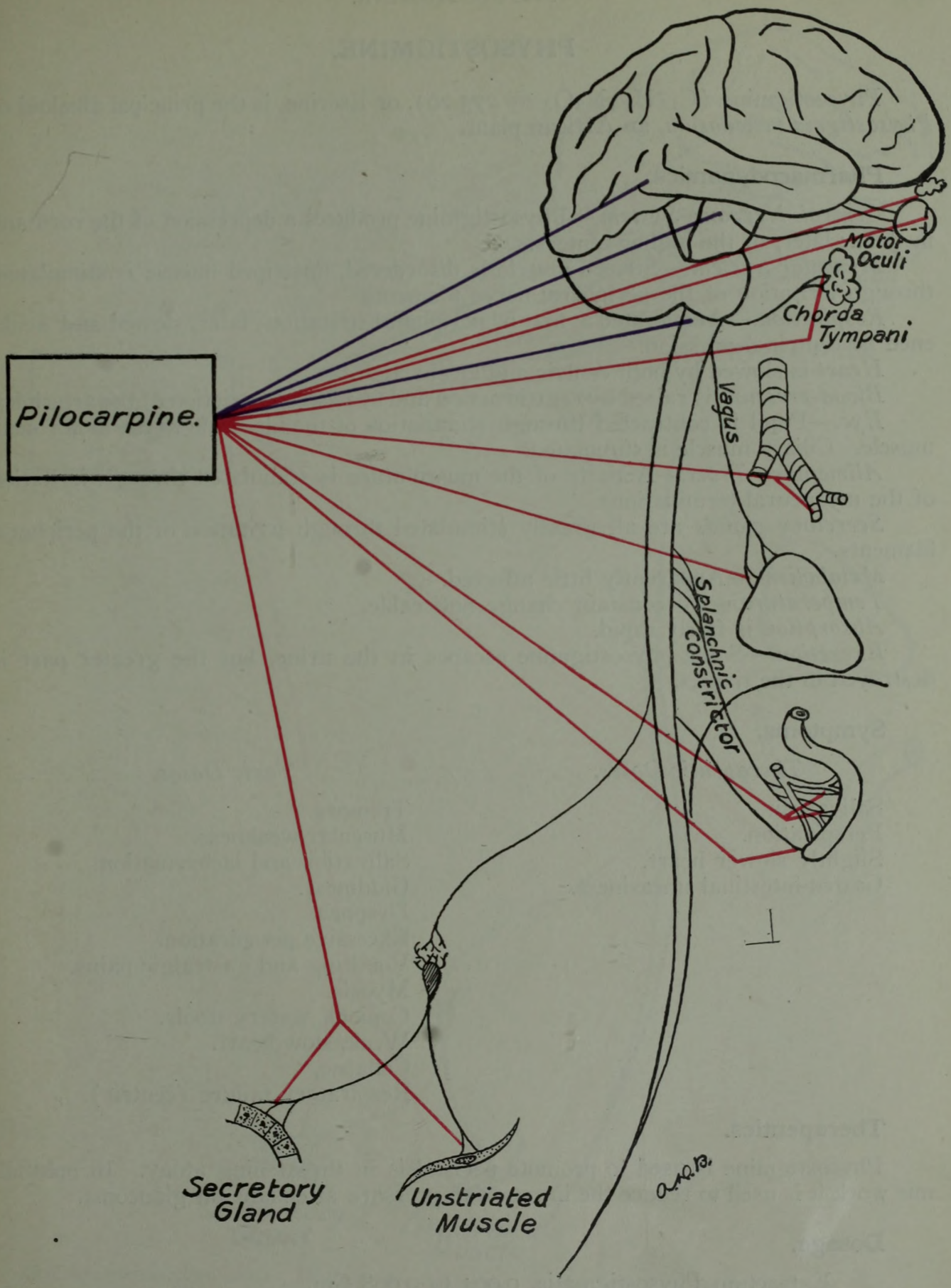
Therapeutic Doses.	*Toxic Doses.*
Salivation.	Excessive salivation, lachrymation and hidrosis.
Lachrymation.	Nausea, retching, and vomiting.
Hidrosis.	Colic, violent peristalsis, and profuse watery stools.
Intestinal discomfort.	Pulse slow and irregular.
	Pupil contracted.
	Respiration quick and dyspneic.
	Mental confusion.
	Tremors, feeble convulsions.
	Respiration weakens and fails.

Therapeutics.

Pilocarpine finds its almost exclusive use as a powerful diaphoretic for grave emergencies. It is used, also, in ophthalmic work to contract the pupil and to reduce intraocular pressure.

Dosage.

Pilocarpinæ Hydrochloridum, 0.008 to 0.03 Gm.
Pilocarpinæ Nitras, 0.008 to 0.03 Gm.



Crimson = stimulation.
Violet = depression.

PHYSOSTIGMINE.

Physostigmine ($C_{15}H_{21}N_3O_3 = 273.20$), or Eserine, is the principal alkaloid of *Physostigma venenosum,* an African plant.

Pharmacodynamics.

Central Nervous System.—Physostigmine produces a depression of the cord and medulla; later, of the higher centers.

Muscular System.—Striped muscle is disordered, unstriped muscle is stimulated, through irritation of the peripheral nerve filaments.

Respiration.—Accelerated at first by peripheral irritation; later, slowed and weakened by centric depression.

Heart is slowed by both centric and local action.

Blood-pressure is raised by centric action and by local constriction of the arterioles.

Eye.—Pupil is contracted through stimulation of the filaments to the motor oculi muscle. Ciliary muscle is stimulated.

Alimentary Tract.—Activity of the musculature is stimulated through irritation of the myoneural terminations.

Secretory glands are all greatly stimulated through irritation of the peripheral filaments.

Metabolism.—Apparently little affected.

Temperature.—No constant change noticeable.

Absorption is fairly rapid.

Excretion.—Some physostigmine escapes in the urine, but the greater part is destroyed in the tissues.

Symptoms.

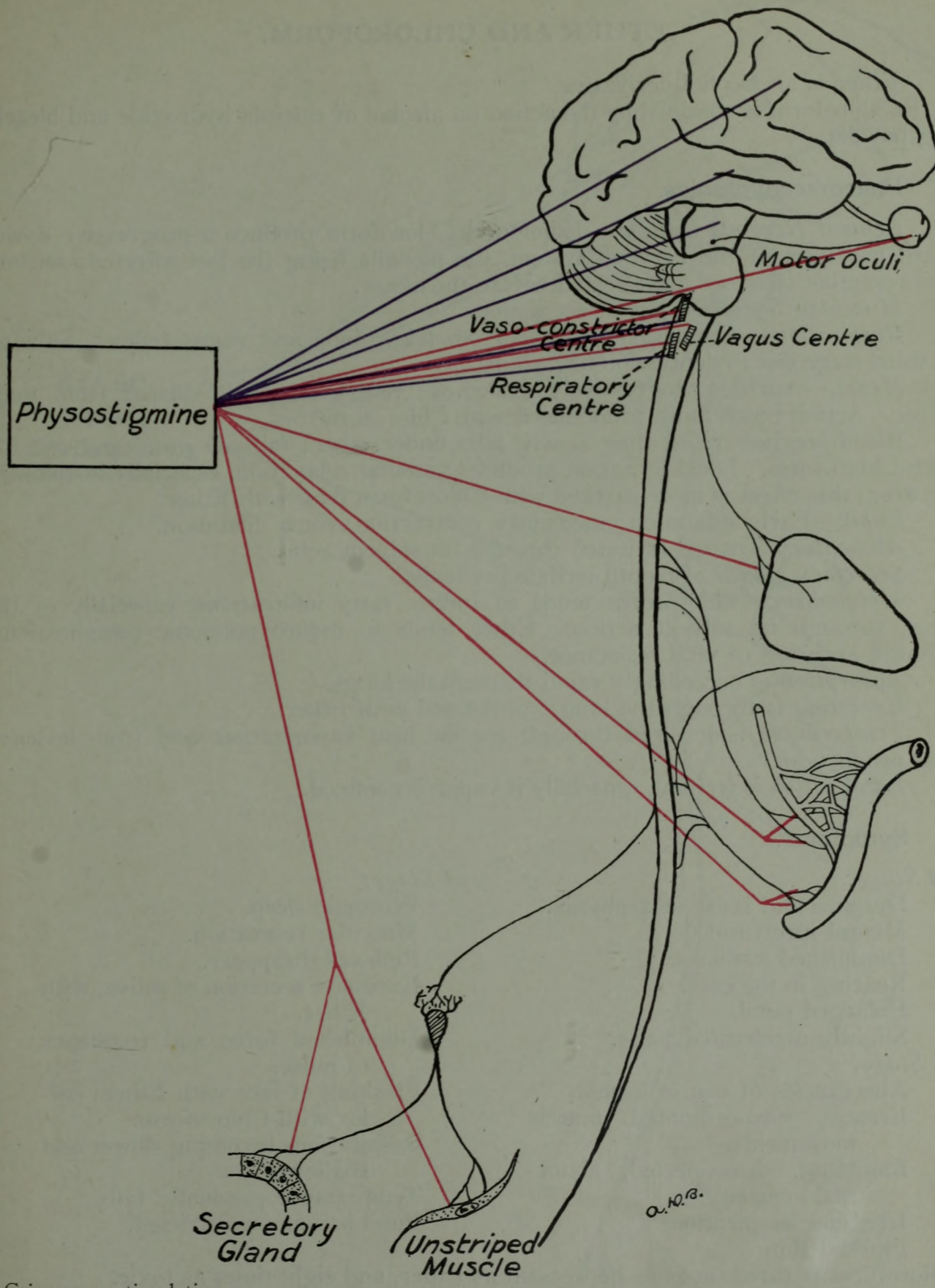
Therapeutic Doses.	*Toxic Doses.*
Salivation.	Tremors.
Perspiration.	Muscular weakness.
Slightly slower heart.	Salivation and lachrymation.
Gastro-intestinal uneasiness.	Giddiness.
	Dyspnea.
	Excessive perspiration.
	Vomiting and gastralgic pains.
	Myosis.
	Copious, watery stools.
	Weak, slow heart.
	Collapse.
	Respiratory failure (centric).

Therapeutics.

Physostigmine is used to promote peristalsis in threatening atony. In ophthalmic work it is used to reduce the intraocular pressure attendant on glaucoma.

Dosage.

Extractum Physostigmatis, 0.004 to 0.008 Gm.
Tinctura Physostigmatis, 0.3 to 1.2 mil.
Physostigminæ Salicylas, 0.001 Gm.
"Eserine" is another name for Physostigmine.



Crimson = stimulation.
Violet = depression.

ETHER AND CHLOROFORM.

Ether is an alcohol derivative.

Chloroform is obtained by the action on alcohol of calcium hydroxide and bleaching powder.

Pharmacodynamics.

Central Nervous System.—Ether and Chloroform produce a progressive downward paralysis of the nervous system, the medulla being the last affected; sensory and receptive synapses are affected before the motor.

Muscular System.—No direct action.

Respiration.—Temporarily slowed from trigeminus and vagus reflex. Slowing in third stage due to depression of medulla.

Heart.—Auricles progressively weakened; ventricles slowly dilated from toxic effect. Action much more pronounced with Chloroform.

Blood-pressure rises, then slowly falls under ether; falls *ab initio* and steadily with Chloroform. Local irritation produces vascular relaxation, especially in splanchnic area; this effect is more marked with Chloroform than with Ether.

Pupil.—Early dilatation; secondary contraction; coma dilatation.

Alimentary Tract.—Irritated through fat-solvent action.

Secretory glands of mouth irritated reflexly.

Metabolism.—Chloroform tends to induce fatty infiltrations, especially of the liver, through its solvent action. Ether tends to induce pulmonic complications, through lowering of vital resistance.

Absorption is exceedingly rapid through the lungs.

Excretion is through the lungs; prolonged with Ether.

Temperature is lowered through specific heat vaporization, and from lessened heat production.

Local action is irritant, especially if vapor is confined.

Symptoms.

1st Stage:

- Dyspnea and sense of asphyxia.
- Mental incertitude.
- Diminished æsthesia.
- Roaring in the ears.
- Enlarged pupil.
- Slightly accelerated pulse.

2d Stage:

- Aberrancies of consciousness.
- Erratic, inco-ordinated muscle movements.
- Rambling, disconnected, abnormal loquacity.
- Irregular respirations.
- Flushed skin.

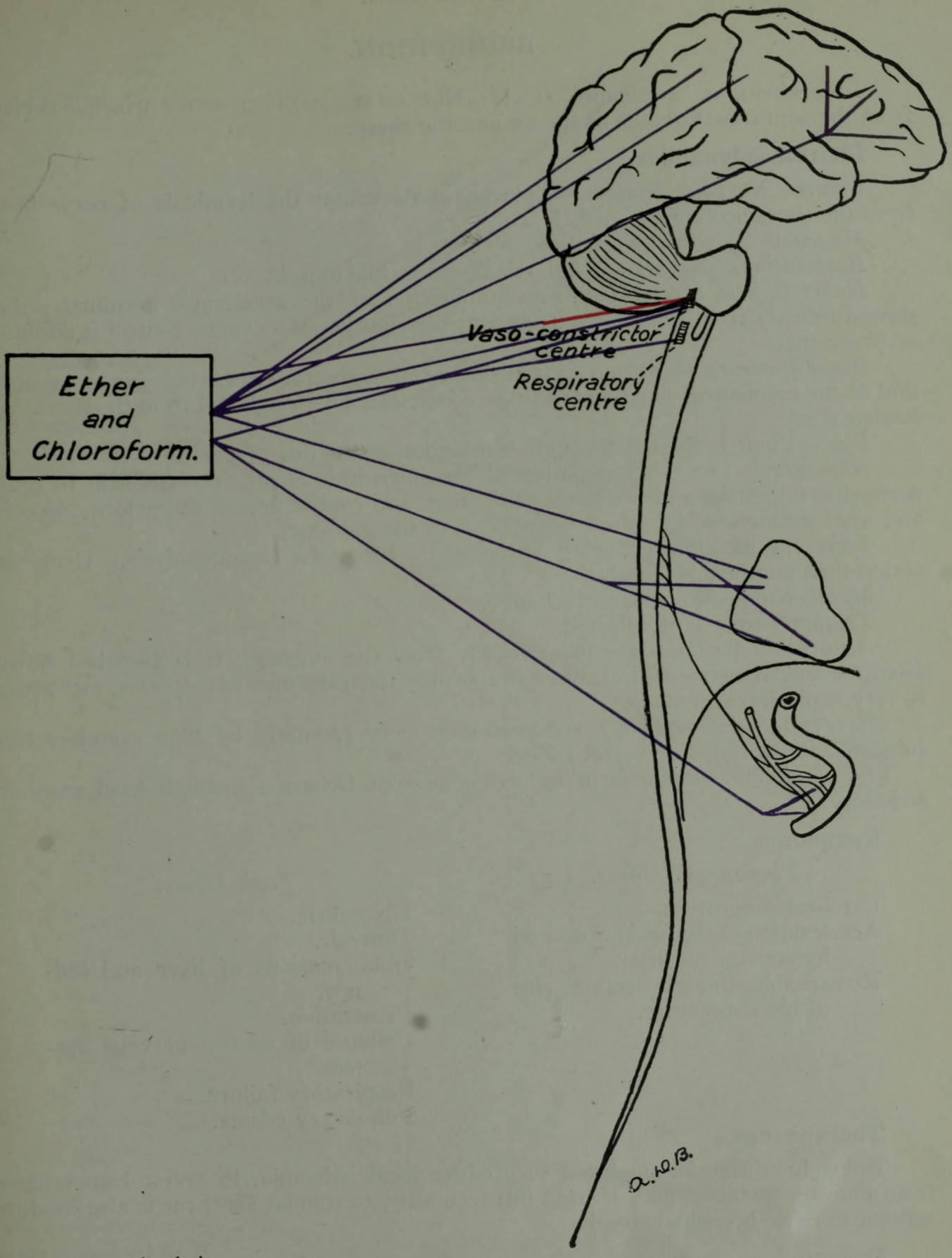
3d Stage:

- Profound sleep.
- Muscular relaxation.
- Reflexes disappear.
- Excessive secretion of saliva, with Ether.
- Diminished force and frequency of pulse.
- Flushing of face with Ether; pallor with Chloroform.
- Respirations becoming slower and shallower.
- Temperature gradually falls.
- Pupil becomes constricted.

Chloroform is three times as depressant as Ether, and eight times as toxic.

Therapeutics.

Ether and Chloroform are used principally as general anæsthetics.



Crimson = stimulation.
Violet = depression.

EPINEPHRIN.

Epinephrin, or "adrenalin" ($C_9H_{13}NO_3 = 181.76$) is an active principle derived from the suprarenal glands of the ox and the sheep.

Pharmacodynamics.

Central Nervous System.—Epinephrin stimulates the terminals of nerve fibers from the thoracicolumbar cord.

Muscular System.—No action.

Respiration.—No action; but relaxes bronchial muscle.

Heart is first accelerated from stimulation of the accelerator terminals; then slowed reflexly from centric vagus action; then quickened as vagus control is inhibited or overcome.

Blood-pressure shows an extraordinary, though transient, rise, due to stimulation of the myoneural junctions of those constrictor fibers supplied from the thoracicolumbar cord.

Eye.—Pupil is dilated through stimulation of the dilator fibers.

Alimentary Tract.—Stimulation of the splanchnic terminations is said to cause peristaltic inhibition and intestinal relaxation, and contraction of the pyloric, ileocolic and anal sphincters; increased movements of the gall-duct.

Secretory glands are slightly stimulated. Increased glycogenolysis. Urine arrested then augmented; local.

Metabolism.—No apparent change.

Temperature.—Not affected.

Absorption does not take place readily from the mucosa. It is absorbed slowly from the subcutaneous tissues, but more readily from the muscular tissues. Its action is very rapid intravenously.

Excretion.—Epinephrin is rendered inert very promptly by some counteracting substance in the blood or vessel walls.

Local Action.—Epinephrin induces a prompt ischæmia through local vasoconstriction.

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Cerebral congestion.	Glycosuria.
Acceleration of the heart, followed by strong, full beat.	Diuresis.
Remarkable, though fleeting, rise of blood-pressure.	Inflammations of liver and kidney.
	Prostration.
	Collapse of central nervous system.
	Respiratory failure.
	Pulmonary edema.

Therapeutics.

Epinephrin may be employed to produce local ischæmia, to arrest hemorrhage from mucous surfaces; and, if used intravenously, to combat shock; it is also used in asthma to relax bronchial spasm.

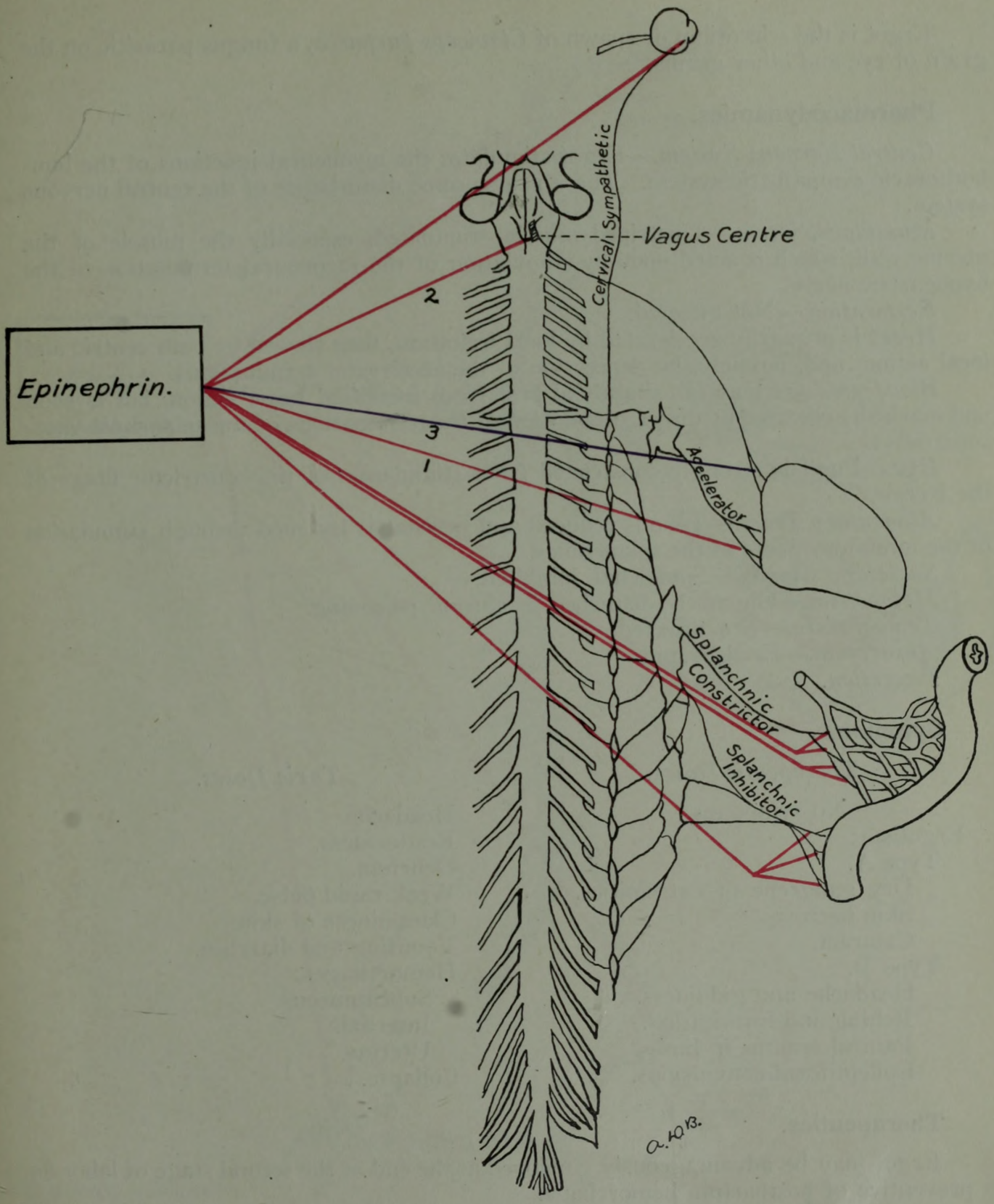
Dosage.

Epinephrin in 1 : 1000 solution.

For local application, use full strength.

For hypodermic use, dilute one-half with normal salt solution.

For intravenous use, dilute 1 to 10 with Locke's solution.



Crimson = stimulation.
Violet = depression.

ERGOT.

Ergot is the sclerotium or spawn of *Claviceps purpurea,* a fungus parasitic on the grain of rye and other grains.

Pharmacodynamics.

Central Nervous System.—Ergot stimulates the myoneural junctions of the lumbothoracic sympathetic system. There is also some disturbance of the central nervous system.

Muscular System.—Unstriped muscle stimulated, especially the muscle of the uterine wall, which is acted upon by stimulation of the myoneural termination of the hypogastric nerve.

Respiration.—Not affected.

Heart is primarily accelerated by local irritation, then slowed by both centric and local action, and, possibly, by depression of the accelerator terminations.

Blood-pressure may fall slightly at first from increased heart action, but is soon and markedly elevated by direct stimulation of the terminations of the splanchnic vasoconstrictors.

Eye.—Pupil is strongly constricted from stimulation of the constrictor fibers of the iris.

Alimentary Tract.—Tone is reduced and peristalsis lessened through stimulation of the inhibitory fibers of the splanchnics.

Secretory Glands.—Somewhat inhibited.

Metabolism.—Obscurely disturbed in chronic poisoning.

Temperature.—Not affected.

Absorption.—Fairly rapid.

Excretion.

Symptoms.

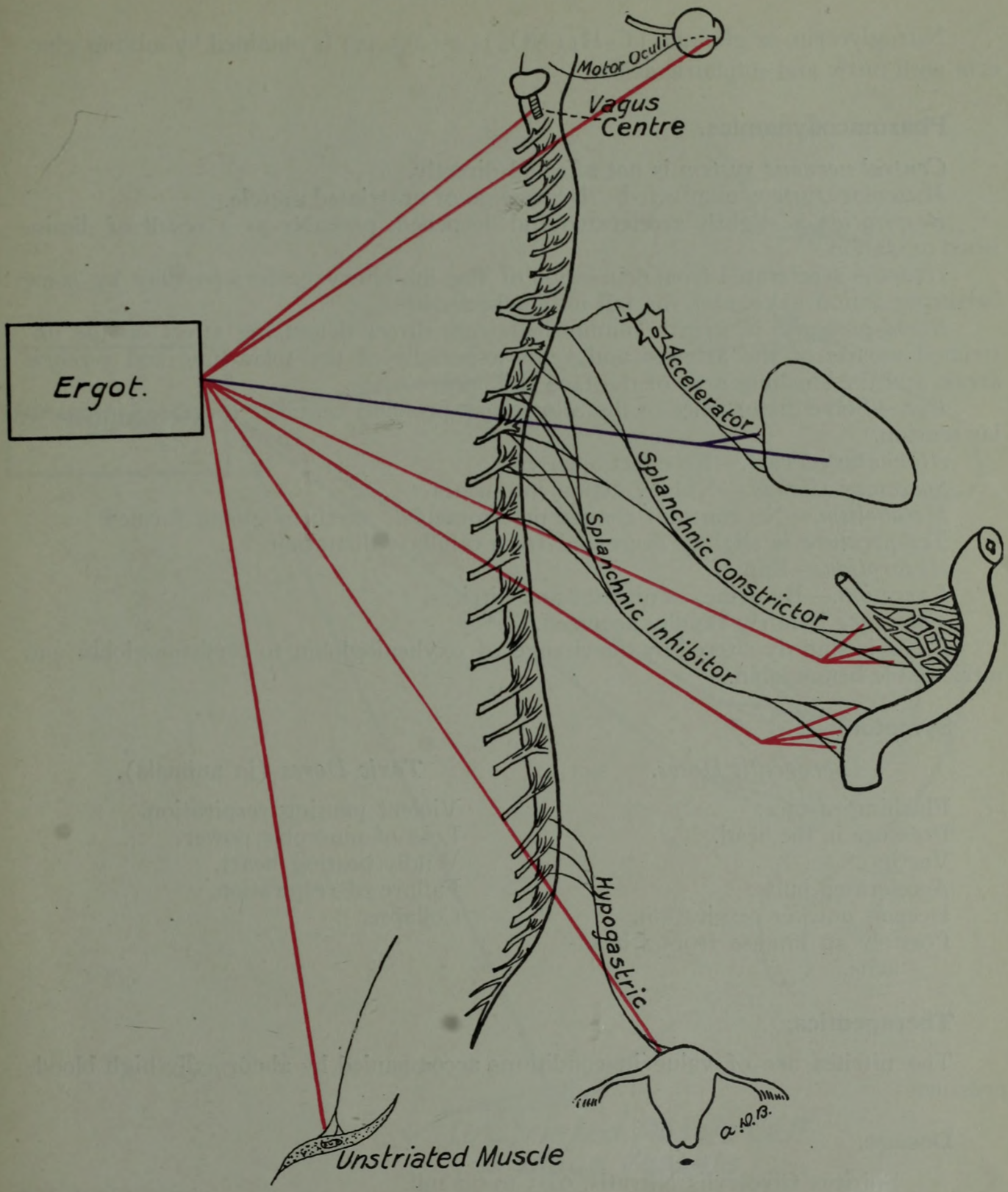
Therapeutic Doses.	*Toxic Doses.*
No symptoms.	Headache.
Ergotism:	Restlessness.
Type A.	Delirium.
Dry gangrene of extremities.	Weak rapid pulse.
Skin necrosis.	Clamminess of skin.
Cataract.	Vomiting and diarrhea.
Type B.	Hemorrhages:
Headache and giddiness.	Subcutaneous.
Itching and formication.	Internal.
Painful cramps in limbs.	Uterine.
Epileptiform convulsions.	Collapse.

Therapeutics.

Ergot may be advantageously employed at the end of the second stage of labor as a preventive of postpartum hemorrhage.

Dosage.

Fluidextractum Ergotæ, 2 to 4 mils.



Crimson = stimulation.
Violet = depression.

NITROGLYCERIN.

Nitroglycerin, or glonoin, ($C_3H_5(NO_3)_3 = 255.44$) is obtained by mixing glycerin with nitric and sulphuric acids.

Pharmacodynamics.

Central nervous system is not affected directly.

Muscular system unaffected. Depression of unstriated muscle.

Respiration is slightly accelerated and deepened, probably as a result of diminished oxidation.

Heart is accelerated from depression of the inhibitory center, possibly by some balancing action to counter the fall in blood-pressure.

Blood-pressure is greatly diminished from direct detonizing effect on the unstriated muscle of the arteries and veins, especially of the splanchnic and cerebral areas, and the blushing area of the face and neck.

Eye.—Some disturbance of the color sense, probably centric. Increased intraocular tension.

Alimentary Tract.—No effect apparent.

Secretory Glands.—Kidney action inconstant.

Metabolism.—No constant change determinable. Methemoglobin formed.

Temperature is slightly decreased from capillary dilatation.

Absorption.—Rapid.

Excretion.—By urine, as nitrates and nitrites.

Tolerance is fairly rapidly acquired.

Blood is slightly altered by the change of oxyhemoglobin to methemoglobin and nitric-oxide-hemoglobin.

Symptoms.

Therapeutic Doses.	*Toxic Doses* (in animals).
Flushing of face.	Violent panting respiration.
Pressure in the head.	Loss of muscular power.
Vertigo.	Wildly beating heart.
Accelerated pulse.	Failure of respiration.
Deeper, quicker respiration.	Collapse.
Possibly an intense frontal headache.	

Therapeutics.

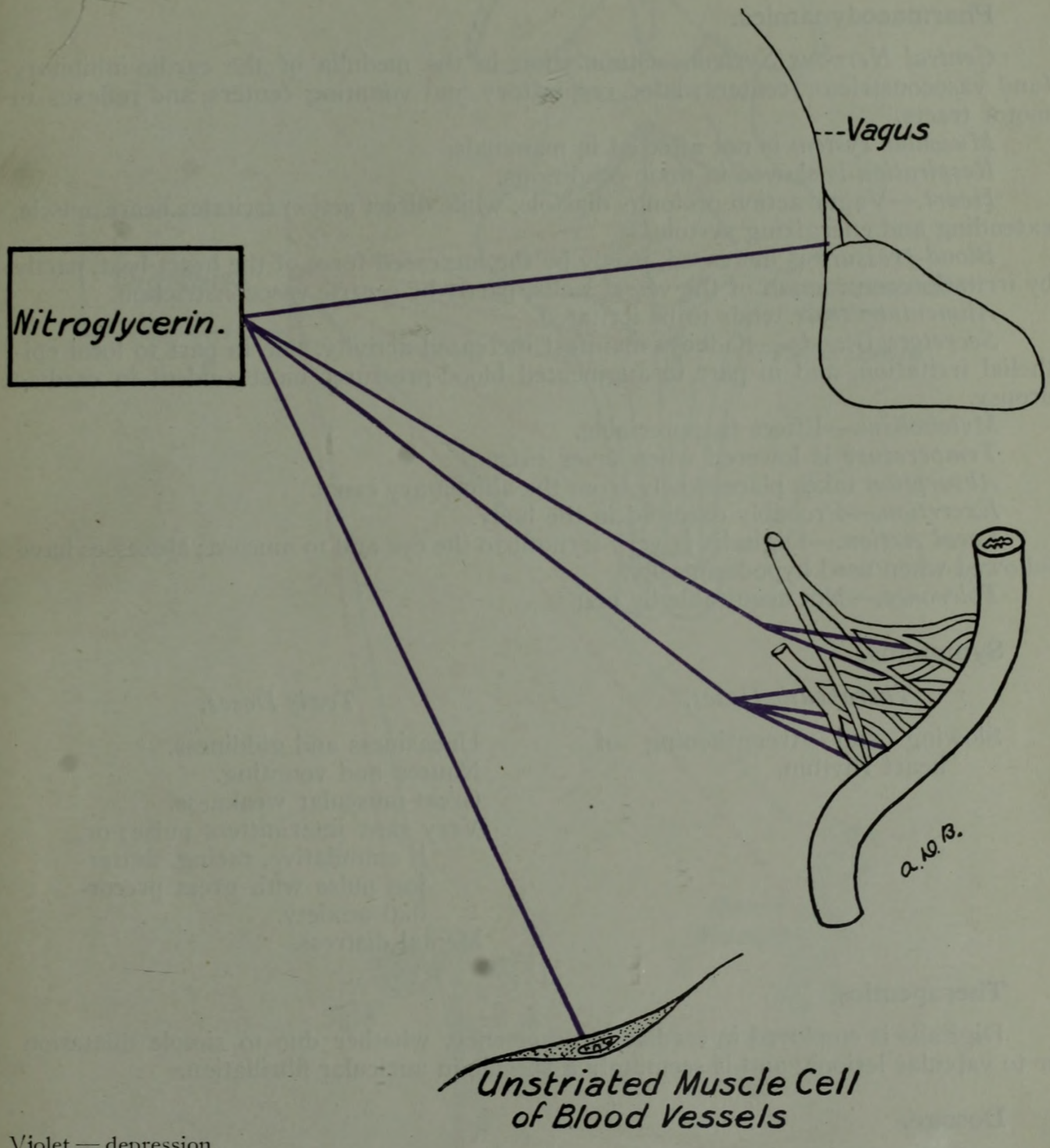
The nitrites are of value in conditions accompanied by abnormally high blood-pressure.

Dosage.

Spiritus Glycerylis Nitratis, 0.03 to 0.2 mil.

Tabellæ Trinitrini, each contain 0.0006 Gm. of nitroglycerin; 1 to 2 tablets.

NOTE.—Symptoms produced by the several nitrites are similar. Amyl Nitrite acts most rapidly, and produces the maximum of flushing; it is also most fleeting. Glonoin is much more prolonged in its action, and is liable to be followed by a severe headache until one has become accustomed to the drug.



Violet = depression.

DIGITALIS.

Digitalis is the dried leaves of the second year's growth of Foxglove, *Digitalis purpurea.*

Pharmacodynamics.

Central Nervous System.—Stimulation in the medulla of the cardio-inhibitory (and vasoconstrictor) centers; later, respiratory and vomiting centers, and reflexes to motor tracts.

Muscular system is not affected in mammals.

Respiration is slowed in toxic conditions.

Heart.—Vagus action prolongs diastole, while direct action irritates heart muscle, extending and energizing systole.

Blood-pressure is increased, partly by the increased force of the heart-beat, partly by irritation contraction of the vessel walls, partly by centric vasoconstriction.

Alimentary tract tends to be irritated.

Secretory Glands.—Kidneys manifest increased activity, due in part to local epithelial irritation, and in part to augmented blood-pressure; most evident in cardiac dropsy.

Metabolism.—Effect inappreciable.

Temperature is lowered when fever exists.

Absorption takes place slowly from the alimentary canal.

Excretion.—Probably oxidized in the body.

Local Action.—Digitalis is very irritant to the eye and to mucosa; abscesses have followed when used hypodermically.

Tolerance.—Not acquirable by man.

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Slowing and strengthening of heart rhythm.	Uneasiness and giddiness. Nausea and vomiting. Great muscular weakness. Very slow intermittent pulse; or, if cumulative, racing, fluttering pulse with great precordial anxiety. Mental distress.

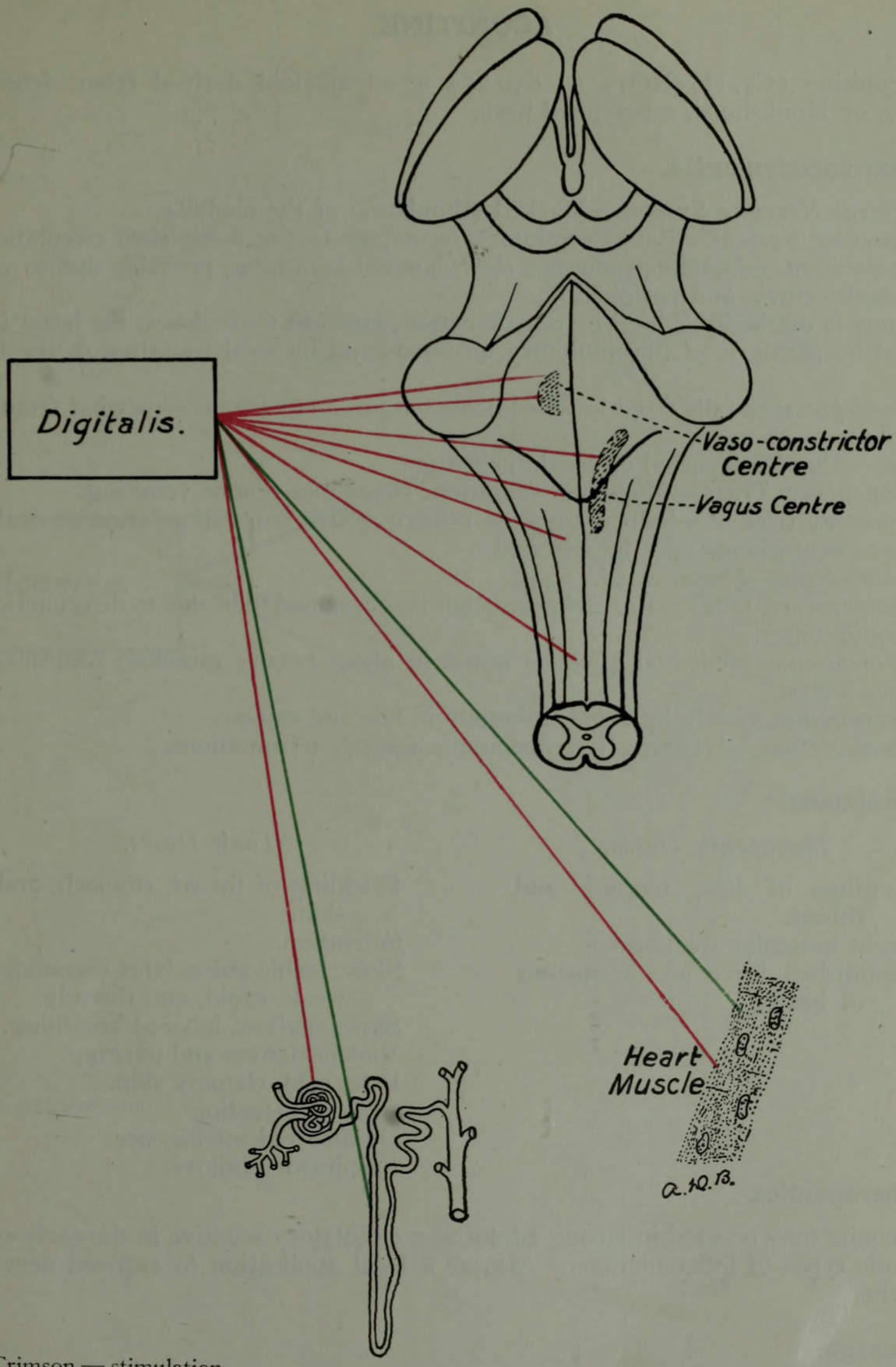
Therapeutics.

Digitalis is employed in cardiac incompetency, whether due to simple dilatation or to valvular lesions; and is seemingly a specific in auricular fibrillation.

Dosage.

Fluidextractum Digitalis, 0.05 mil.
Tinctura Digitalis, 0.3 to 1 mil, repeated very cautiously.

Digitalis is slowly absorbed, but its effect is prolonged. A single dose will keep the heart slowed for several days. Therefore, repeated doses are liable to produce a cumulative effect, with severe toxic symptoms.



Crimson = stimulation.
Green = irritation.

ACONITINE.

Aconitine ($C_{34}H_{47}NO_{11}$ = 640.55) is an alkaloid derived from *Aconitum napellus,* or Monkshood, a perennial herb.

Pharmacodynamics.

Central Nervous System.—Marked stimulation of the medulla.

Muscular System.—Reflex weakness, secondary to the diminished circulation.

Respiration.—Aconite produces a slow, labored breathing, probably due to vagus action, both centric and peripheral.

Heart is markedly slowed by centric action; later, in toxic doses, the heart is accelerated by paralysis of the inhibitory terminals and by local irritation of the heart muscle.

Blood-pressure falls from lessened heart output, and perhaps somewhat from centric action.

Eye.—Pupil contracted on local application.

Alimentary Tract.—Numbing sensation; sometimes centric vomiting.

Secretory Glands.—Salivary glands reflexly active from stimulation of oral terminants; sweat-glands may be irritated.

Metabolism.—Not affected.

Temperature falls; cause unknown, but it is assumed to be due to direct action on the thermic center.

Absorption.—Medicinal effect is noted in about twenty minutes; continues for about five hours.

Excretion is mainly by urine; minutely in bile and saliva.

Local Action.—Irritates, later benumbs, sensory terminations.

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Tingling of lips, tongue, and throat.	Prickling of throat, stomach, and skin.
Slight muscular weakness.	Salivation.
Diminished force and frequency of heart.	Slow, feeble pulse, later becoming weak, rapid, and thready.
	Slow, shallow, labored breathing.
	Violent nausea and purging.
	Pale, cold, clammy skin.
	Great prostration
	Unimpaired intelligence.
	Respiratory failure.

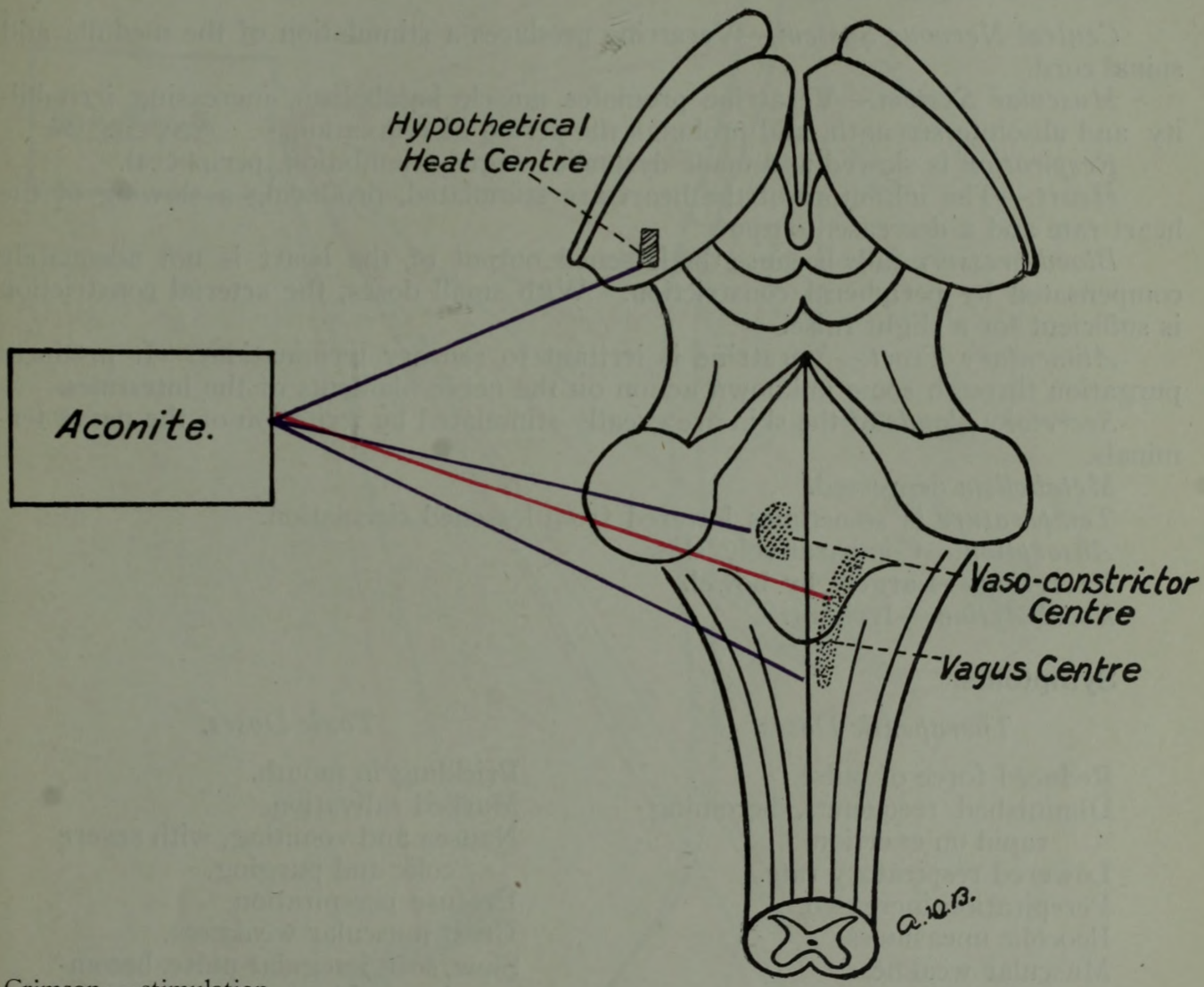
Therapeutics.

Aconite may be used in strong adults as a circulatory sedative in the early stages of sthenic types of inflammations. Also as a local application to exposed nerves in toothache.

Dosage.

Fluidextractum Aconiti, 0.03 to 0.12 mil.
Tinctura Aconiti, 0.3 to 2 mils.
Aconitina, 0.00016 to 0.00032 Gm.

Aconitina should be used with great circumspection, and never administered to children.



Crimson = stimulation.
Violet = depression.

VERATRINE.

Veratrine ($C_{32}H_{52}N_2O_8 = 588.02$) is an alkaloid found in the rhizome and rootlets of *Veratrum viride,* or Green Hellebore, a perennial herb of northern America, Europe, and Asia.

Pharmacodynamics.

Central Nervous System.—Veratrine produces a stimulation of the medulla and spinal cord.

Muscular System.—Veratrine promotes muscle katabolism, increasing irritability and absolute strength, and prolongs the period of relaxation.

Respiration is slowed and made dyspneic; vagus stimulation, peripheral.

Heart.—The inhibitors of the heart are stimulated, producing a slowing of the heart-rate and a decreased output.

Blood-pressure falls because the lessened output of the heart is not adequately compensated by peripheral constriction. With small doses, the arterial constriction is sufficient for a slight raise.

Alimentary Tract.—Veratrine is irritant to sensory terminations. It produces purgation through some unknown action on the nerve filaments of the intestines.

Secretory glands of the skin are greatly stimulated by irritation of the nerve terminals.

Metabolism depressed.

Temperature is sometimes lowered from lessened circulation.

Absorption.—Comparatively slow.

Excretion.—Largely by bowel.

Local Action.—Irritant.

Symptoms.

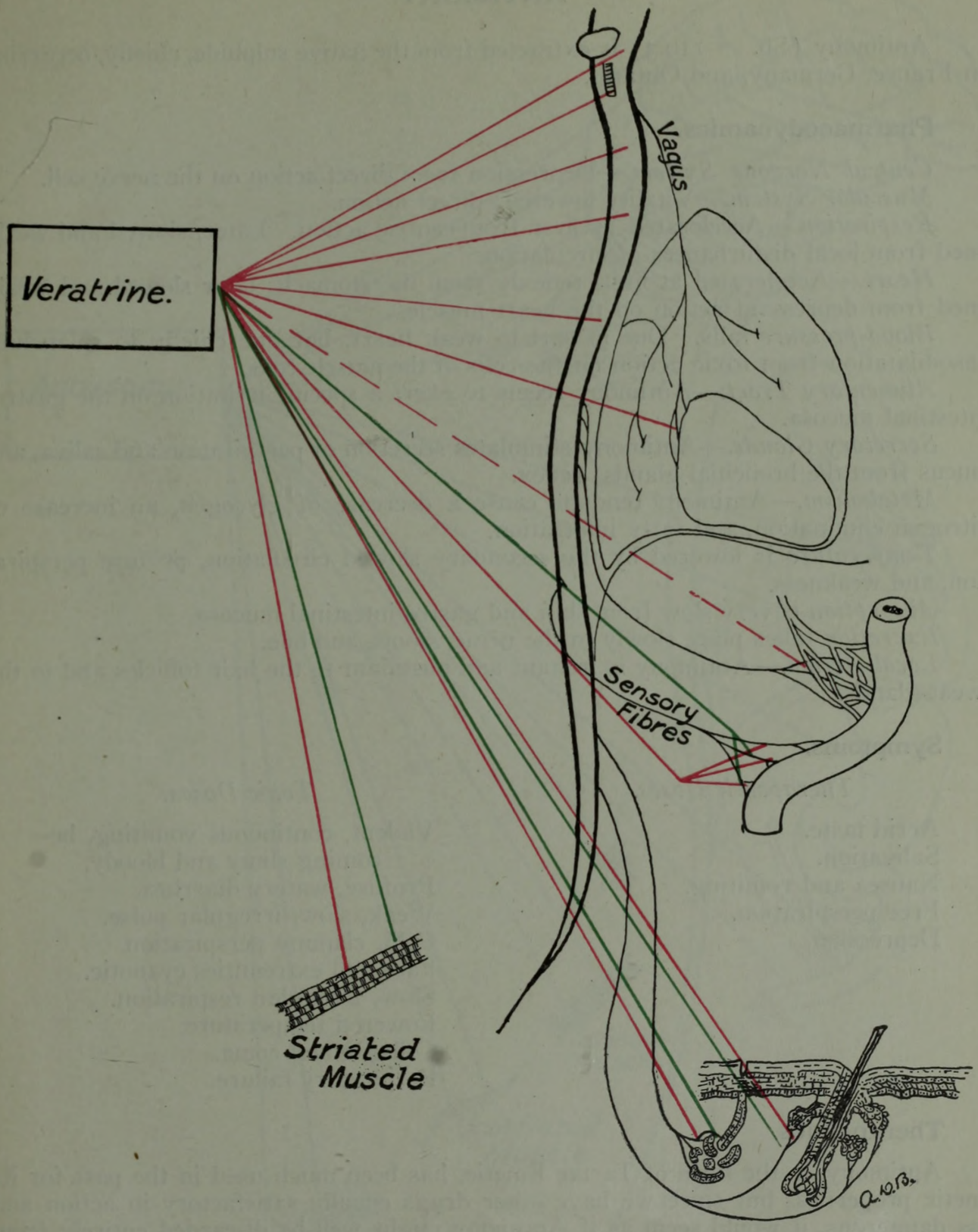
Therapeutic Doses.	*Toxic Doses.*
Reduced force of pulse.	Prickling in mouth.
Diminished frequency, becoming rapid on exertion.	Marked salivation.
Lowered respiratory rate.	Nausea and vomiting, with severe colic and purging.
Perspiration increased.	Profuse perspiration.
Ileocolic uneasiness.	Great muscular weakness.
Muscular weakness.	Slow, soft, irregular pulse, becoming feeble and thready.
	Slow, dyspneic breathing.
	Collapse.
	Respiratory failure.

Therapeutics.

Veratrine has practically the same indications as Aconite, being used to quiet circulation in the early stages of sthenic inflammations.

Dosage.

Fluidextractum Veratri, 0.06 to 0.2 mil.
Tinctura Veratri, 0.6 to 2 mils.



Crimson = stimulation.
Green = irritation.

ANTIMONY.

Antimony (Sb. = 119.3) is extracted from the native sulphide, chiefly, occurring in France, Germany, and Ontario.

Pharmacodynamics.

Central Nervous System.—Depression from direct action on the nerve cell.

Muscular System.—Vitality lowered; direct action.

Respiration.—Accelerated at first from centric action. Later, slowed and weakened from local disturbances of circulation.

Heart.—Accelerated at first, reflexly from the stomach; later slowed and weakened from depressant action on the heart muscle.

Blood-pressure falls. Due in part to weak heart, but due chiefly to splanchnic vasodilatation from toxic action on the cells of the muscle coat.

Alimentary Tract.—Antimony seems to exert a specific irritation on the gastro-intestinal mucosa.

Secretory Glands.—Antimony stimulates secretion of perspiration and saliva, and mucus from the bronchial glands; reflex.

Metabolism.—Antimony tends to cause a decrease of glycogen, an increase of nitrogen elimination, and fatty infiltration.

Temperature is lowered by the secondary slowed circulation, profuse perspiration, and weakness.

Absorption is very slow from skin and gastro-intestinal mucosa.

Excretion takes place slowly in the urine, stools, and bile.

Local Action.—Antimony is irritant and pustulant to the hair follicles and to the sweat-glands.

Symptoms.

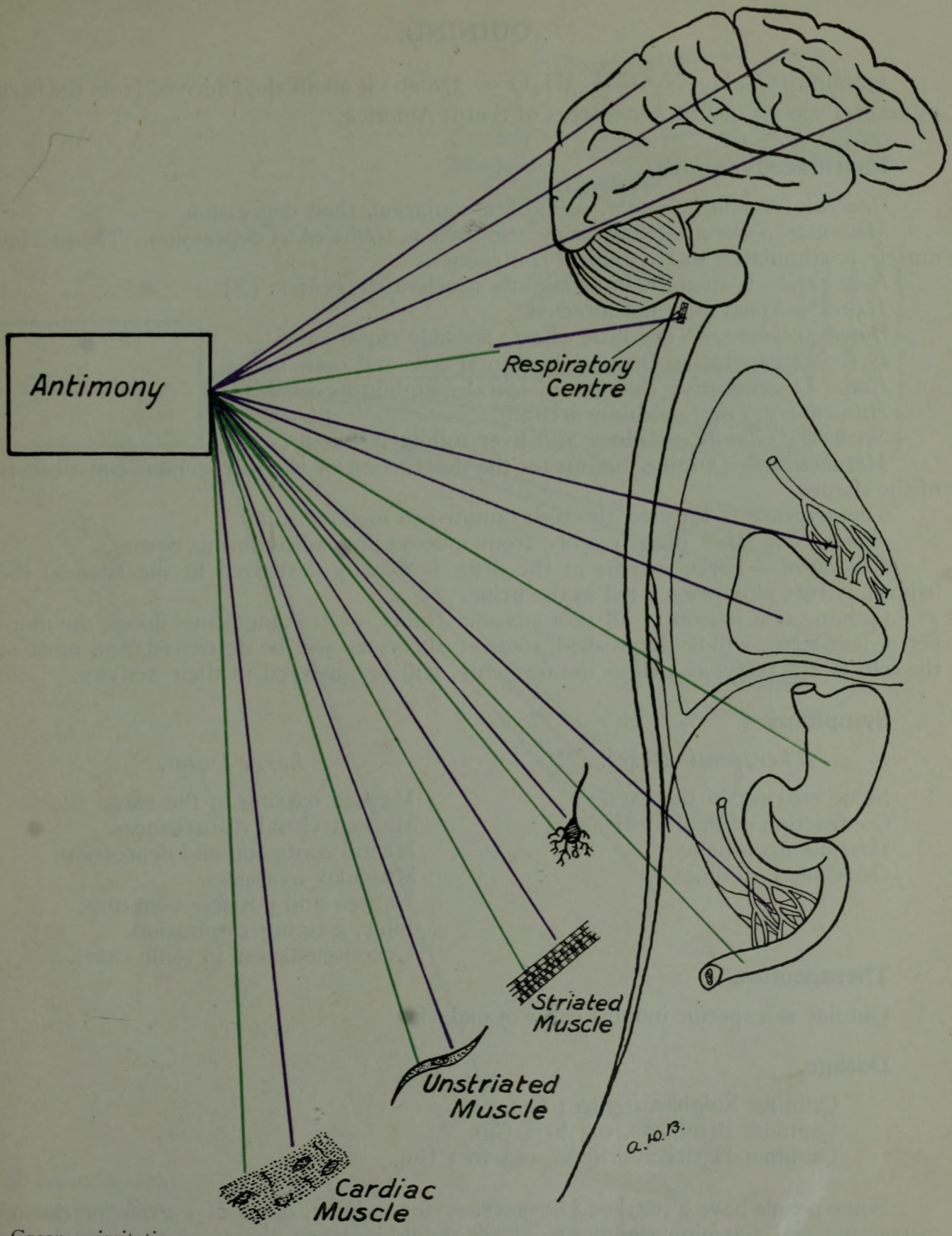
Therapeutic Doses.	*Toxic Doses.*
Acrid taste.	Violent, continuous vomiting, becoming slimy and bloody.
Salivation.	Profuse, watery diarrhea.
Nausea and vomiting.	Weak, slow, irregular pulse.
Free perspiration.	Cold, clammy perspiration.
Depression.	Face and extremities cyanotic.
	Slow, irregular respiration.
	Lowered temperature.
	Collapse and coma.
	Respiratory failure.

Therapeutics.

Antimony, in the form of Ta-tar Emetic, has been much used in the past for its emetic properties; but since we have other drugs equally satisfactory in action and less dangerous, it would seem as if Antimony might well be discarded entirely from the Materia Medica.

Dosage.

Antimonii et Potassii Tartras, 0.03 to 0.1 Gm. (0.1 Gm. has proved fatal in some cases.)



Green = irritation.
Violet = depression.

QUININE.

Quinine ($C_{20}H_{24}N_2O_2 + 3H_2O = 378.26$) is an alkaloid derived from the bark of several species of *Cinchona,* trees of South America.

Pharmacodynamics.

Central Nervous System.—Slight stimulation, then depression.

Muscular System.—Temporary stimulation, followed by depression. The uterine muscle is stimulated to rhythmical contractions.

Respiration is thought to be slightly accelerated; centric (?)

Heart.—Apparently not affected.

Blood-pressure.—Very little effect; possibly slight raise.

Eye.—Degenerative changes in retinal cells and optic nerve.

Ear.—Degenerative changes in spiral ganglion in cochlea.

Alimentary Tract.—Mildly irritant.

Secretory Glands.—Kidney and liver mildly irritated.

Metabolism.—Quinine diminishes the destruction of the nitrogenous constituents of the tissues.

Temperature is lowered through diminished metabolism.

Absorption takes place readily from mucosa and subcutaneous tissues.

Excretion.—Three-fourths of the drug is usually destroyed in the tissues; the balance is very slowly excreted in the urine.

Quinine is a poison to all protoplasm. Hence, even in medicinal doses, the number of leucocytes will be diminished, some erythrocytes will be destroyed, and most of the cells of the body, as well as the ferments, will be hindered in their activity.

Symptoms.

Therapeutic Doses.	*Large Doses.*
Some roaring in the ears.	Marked roaring in the ears.
Contraction of field of vision.	Marked visual disturbances.
Possible exanthems.	Mental confusion and depression.
Occasional giddiness.	Muscular weakness.
	Nausea and possible vomiting.
	Slow, gasping respiration.
	Unconsciousness in some cases.

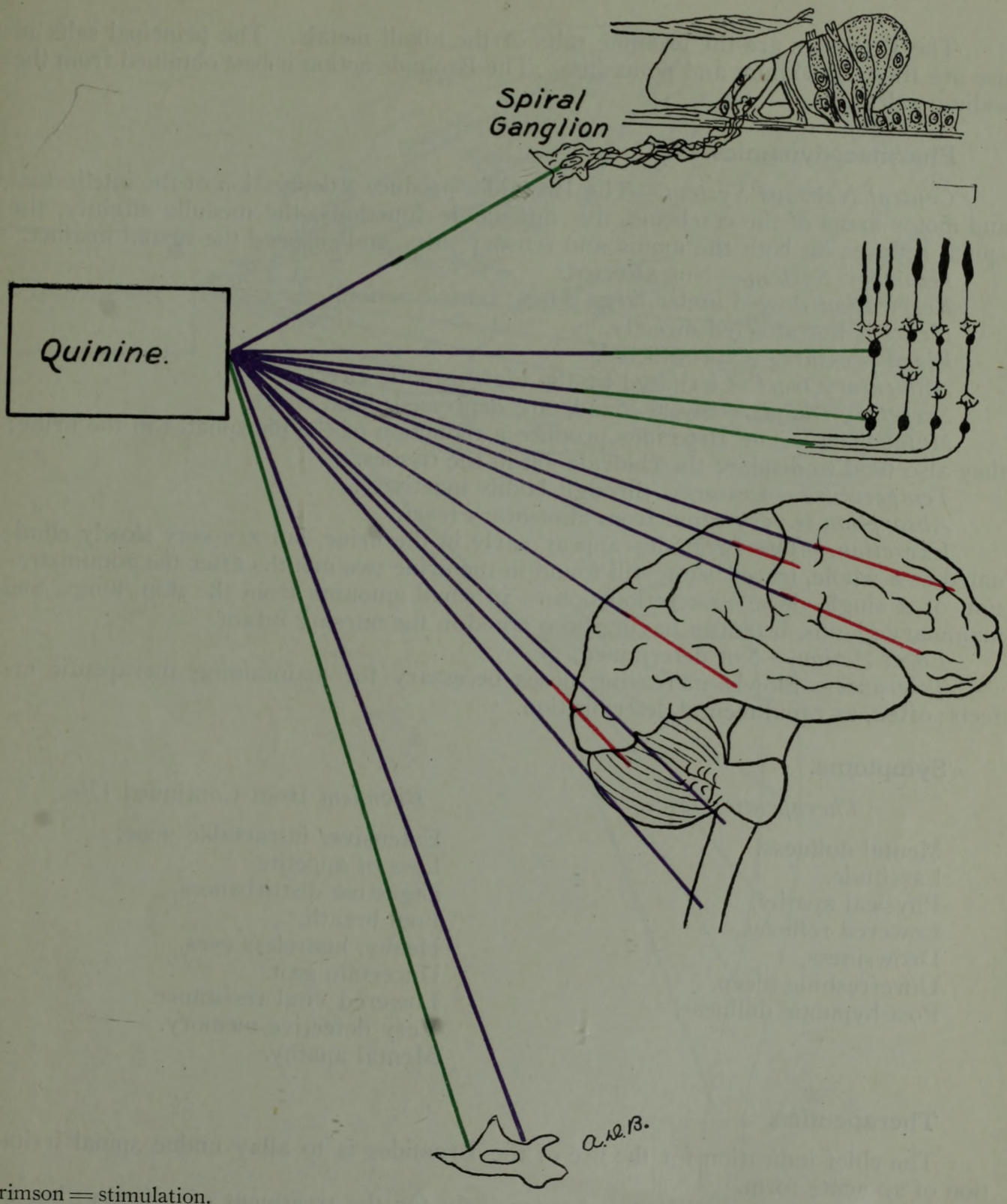
Therapeutics.

Quinine is a specific in most cases of malaria.

Dosage.

Quininæ Sulphas, 0.3 to 1 Gm.
Quininæ Bisulphas, 0.3 to 1 Gm.
Quininæ Hydrochloridum, 0.3 to 1 Gm.

Some people have a marked idiosyncrasy for quinine, doses of 1 grain producing distressing and alarming symptoms. Care should be taken, therefore, to ascertain the way a given patient may react.



Crimson = stimulation.
Green = irritation.
Violet = depression.

BROMIDES.

The Bromides are the bromine salts of the alkali metals. The principal salts in use are those of sodium and potassium. The Bromide action is best obtained from the sodium salt.

Pharmacodynamics.

Central Nervous System.—The Bromides produce a depression of the intellectual and motor areas of the cerebrum, the mnemonic functions, the medulla slightly, the spinal reflexes on both the motor and sensory sides, and suspend the sexual instinct.

Muscular System.—Not affected.

Respiration slowed under large doses; centric action.

Heart is not affected directly.

Blood-pressure.—Not affected.

Alimentary tract is irritated by the high osmotic effect.

Secretory Glands.—Sweat-glands are depressed; local effect.

Metabolism.—The Bromides produce a reduction of the phosphates in the urine; they also tend to displace the chloride ion in the tissues.

Temperature.—Lessened through bodily inactivity.

Absorption is very rapid from alimentary tract.

Excretion.—The Bromides appear early in the urine, but are very slowly eliminated as a whole, traces being still found in the urine two months after the administration of a single dose. Excretion occurs in small amounts from the skin, lungs, and mammary glands, bromism having been noted in the nursing infant.

Local Action.—Not determined.

Tolerance.—Slowly increasing doses necessary for maintaining therapeutic effects; often, as rapid mental deterioration.

Symptoms.

Therapeutic Doses.	*Bromism* from Continued Use.
Mental dullness.	Extensive, intractable acne.
Lassitude.	Loss of appetite.
Physical apathy.	Digestive disturbances.
Lowered reflexes.	Foul breath.
Drowsiness.	Heavy, lustreless eyes.
Unrefreshing sleep.	Uncertain gait.
Post-hypnotic dullness.	Lowered vital resistance.
	Very defective memory.
	Mental apathy.

Therapeutics.

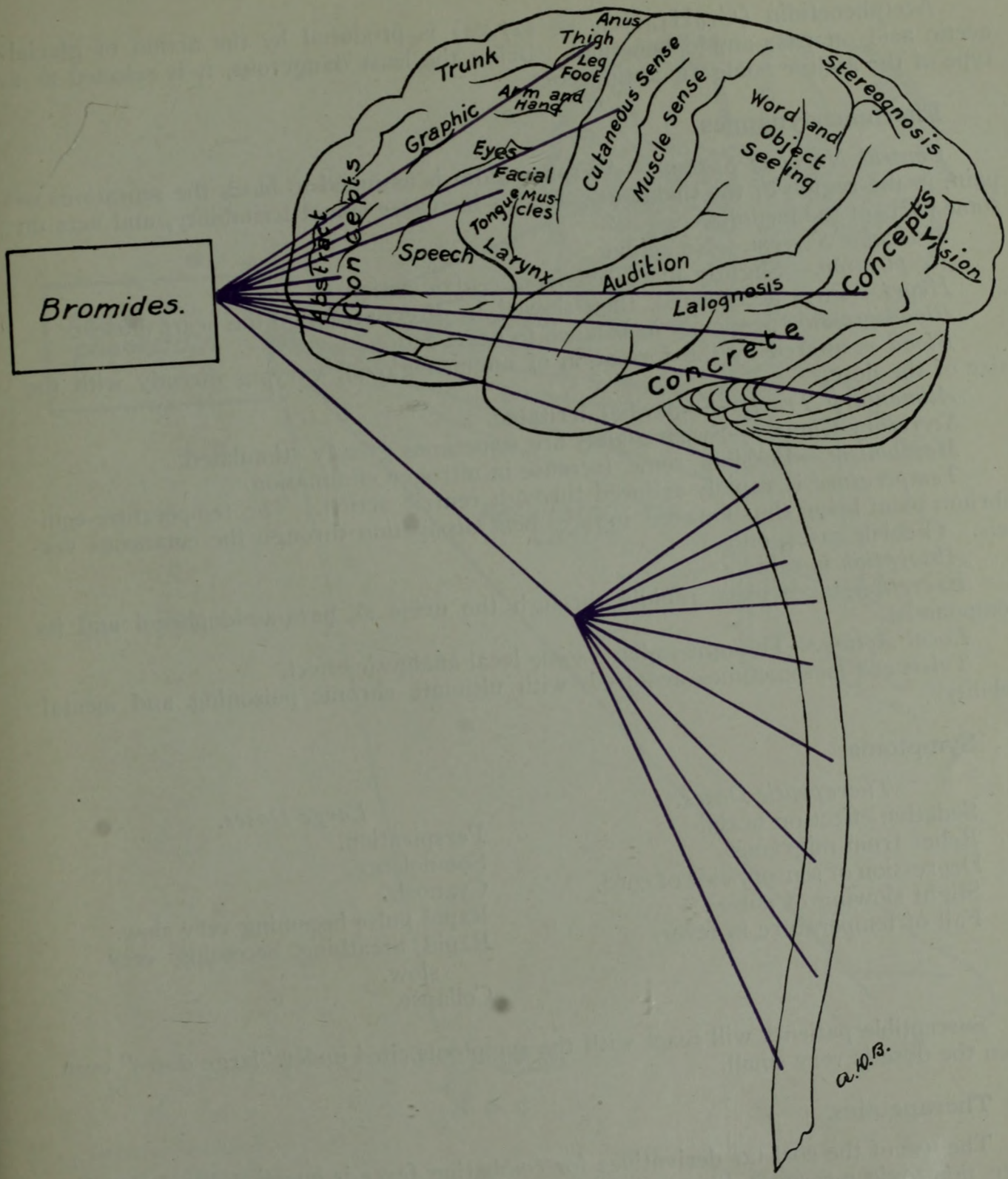
The chief indication for the use of the Bromides is to allay undue spinal irritation of an acute form.

The Bromides have been used extensively for the treatment of epilepsy; but as the patients are never cured by the treatment, and as the continued use of the Bromides entails an inevitable mental and physical deterioration, this method of treatment becomes very questionable.

The Bromides ought never to be given to normal children.

Dosage.

Sodii Bromidum, 1 to 4 Gm.



Violet = depression.

ACETPHENETIDIN.

Acetphenetidin ($C_{10}H_{13}NO_2 = 177.79$) is produced by the action of glacial acetic acid on para-amidophenetidol. Being the least dangerous, it is selected as a type of the aniline analgesic antipyretics.

Pharmacodynamics.

Central Nervous System.—Acetphenetidin is assumed to block the sensations of pain, in the region of the thalamus. It also increases spinal irritability, and acts on some parts of the medulla.

Muscular System.—No action.

Respiration.—Slightly increased from centric action.

Heart.—First accelerated, then slowed, by direct action on the heart muscle.

Blood-pressure responds in balance to heart action.

Blood is altered by the formation of methemoglobin, varying directly with the size of the dose.

Alimentary Tract.—Somewhat irritated.

Secretory Glands.—Sweat-glands are sometimes greatly stimulated.

Metabolism.—Possibly some increase in nitrogen elimination.

Temperature is rapidly reduced through centric action. The temperature-equilibrium point being thus lowered induces heat dissipation through the cutaneous vessels. (Febrile cases, only.)

Absorption is rapid.

Excretion takes place rapidly through the urine as para-amidophenol and its compounds.

Local Action.—Thought to have some local analgesic effect.

Tolerance is sometimes acquired, with ultimate chronic poisoning and mental debility.

Symptoms.

Therapeutic Doses.	*Large Doses.*
Sedative effect on brain.	Perspiration.
Relief from migraine.	Somnolence.
Depression of sensory side of cord.	Cyanosis.
Slight slowing of pulse.	Rapid pulse becoming very slow.
Fall of temperature in fever.	Rapid breathing becoming very slow.
	Collapse.

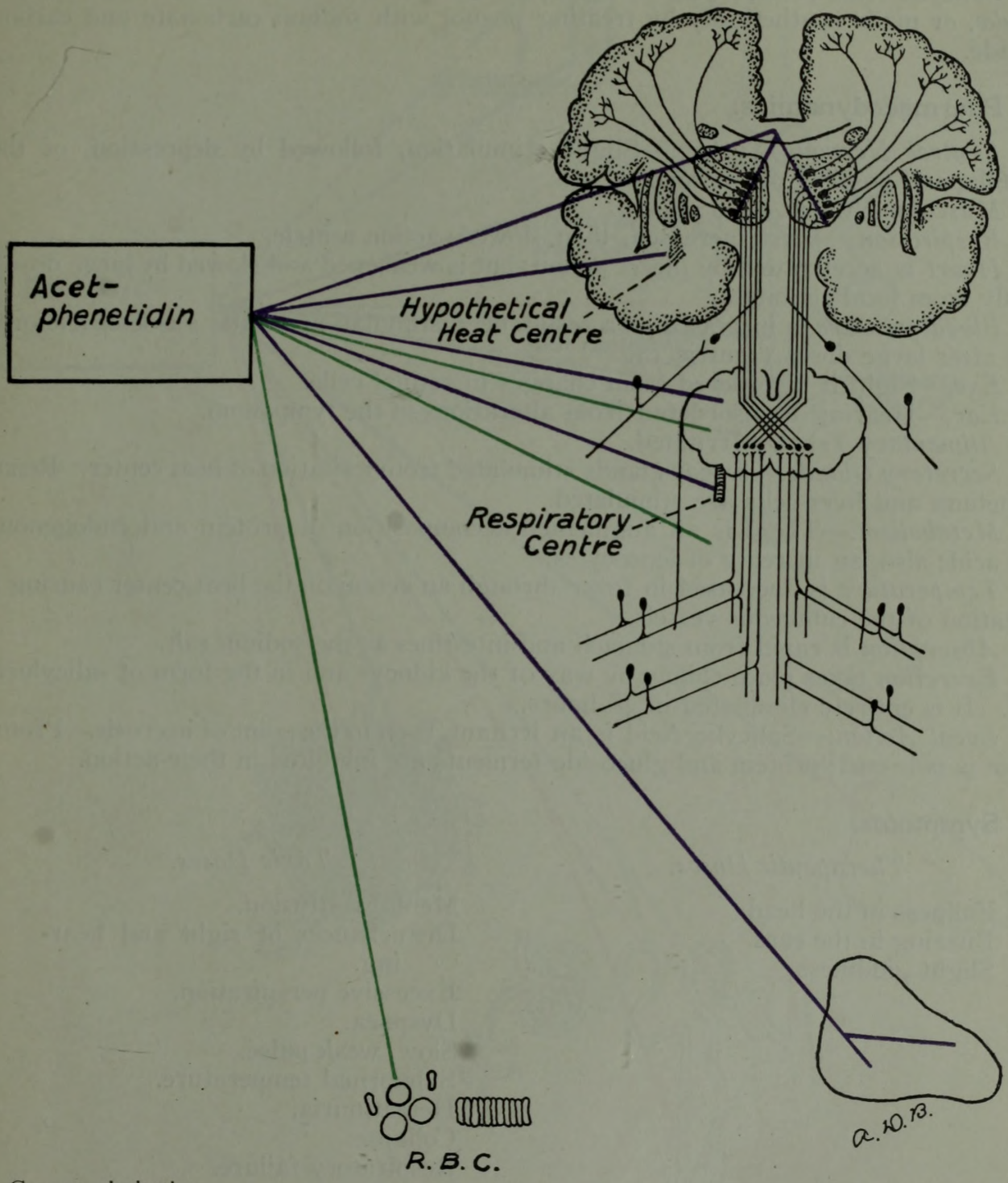
Susceptible patients will react with the symptoms cited under "large doses" even when the dose is very small.

Therapeutics.

The use of the coal-tar derivatives for combating fever is questionable, especially when non-toxic measures, like cool sponging, give amply good results. But in migraines and neuralgias, acetphenetidin may be used advantageously, due caution being exercised as to the possibility of toxicity.

Dosage.

Acetphenetidinum, 0.3 to 0.6 Gm.



Green = irritation.
Violet = depression.

SALICYLIC ACID.

Salicylic Acid ($HC_7H_5O_3 = 137.05$) is a monobasic acid obtained from *Oleum Betulæ,* or made synthetically by treating phenol with sodium carbonate and carbon dioxide.

Pharmacodynamics.

Central Nervous System.—Slight stimulation, followed by depression, of the medulla, and possibly of the cord.

Muscular System.—No effect.

Respiration.—First increased, then slowed; action centric.

Heart is accelerated, by direct action; but is weakened and slowed by large doses, chiefly from local action.

Blood-pressure is increased as a result of a stimulation of the vasoconstrictors; falls after large doses (centric ?).

Eye.—Sight is disordered from changes in retinal cells.

Ear.—Hearing is disordered from alterations in the tympanum.

Alimentary Tract.—Irritated.

Secretory Glands.—Sweat-glands stimulated from irritation of heat center. Renal epithelium and liver-cells are stimulated.

Metabolism.—There is an augmented decomposition of protein and endogenous uric acid; also, an increase of leucocytes.

Temperature is decreased in fever through an action on the heat center causing a dilatation of the cutaneous vessels.

Absorption is rapid from stomach and intestines as the sodium salt.

Excretion takes place chiefly by way of the kidneys and in the form of salicyluric acid. It is entirely eliminated in 48 hours.

Local Action.—Salicylic Acid is an irritant, even to the point of necrosis. Protoplasm is poisoned; protein and glucoside ferments are inhibited in their action.

Symptoms.

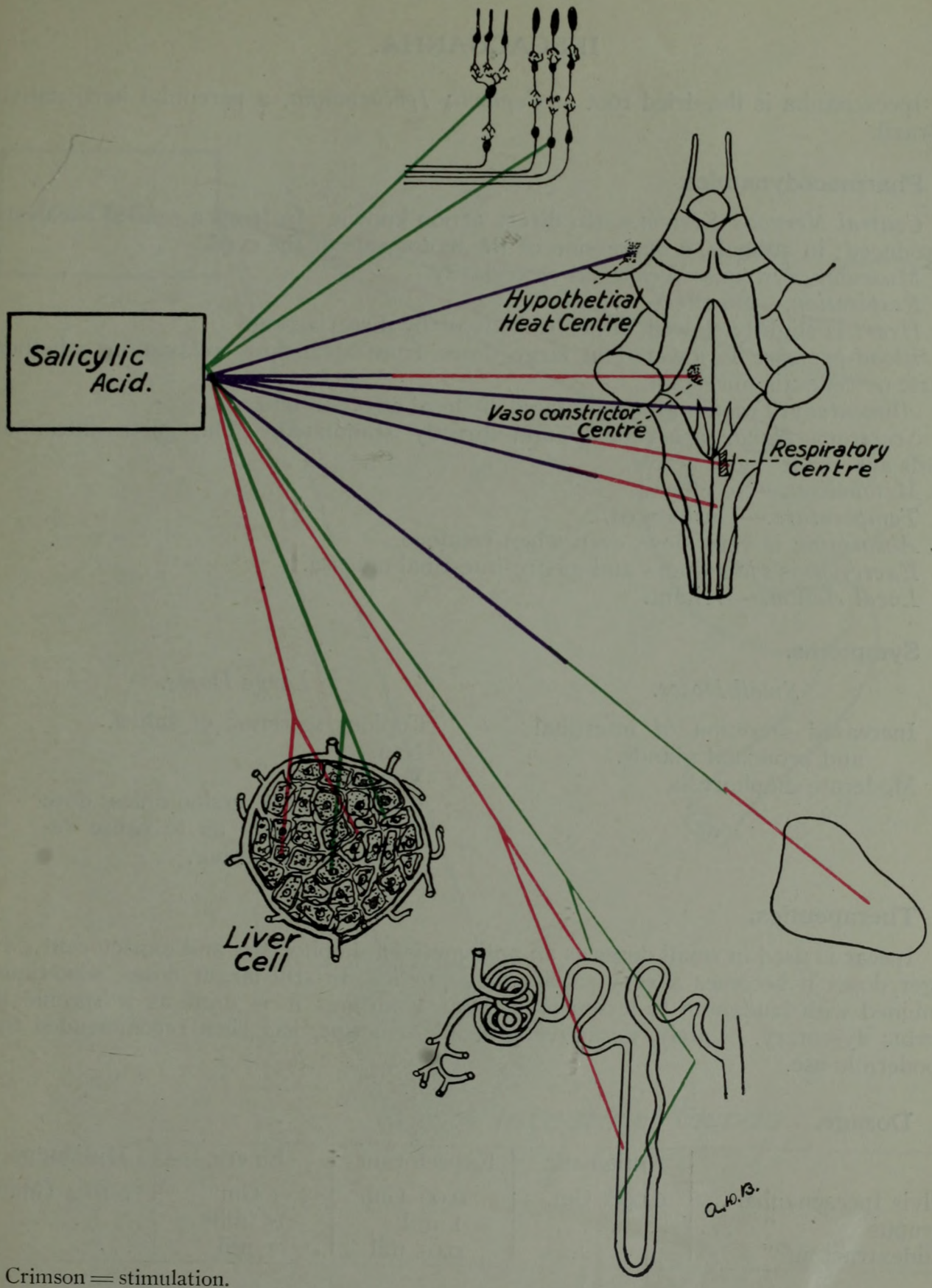
Therapeutic Doses.	*Toxic Doses.*
Fullness in the head.	Mental confusion.
Buzzing in the ears.	Disturbances of sight and hearing.
Slight giddiness.	Excessive perspiration.
	Dyspnea.
	Slow, weak pulse.
	Subnormal temperature.
	Hematinuria.
	Collapse.
	Respiratory failure.

Therapeutics.

Salicylic Acid, and its salts, have been employed successfully in the treatment of acute rheumatic fever. Its action in rheumatic fever is not understood.

Dosage.

Acidum Salicylicum, 0.3 to 2 Gm.
Sodii Salicylas, 0.6 to 2 Gm.
Phenylis Salicylas, 0.5 to 2 Gm.



Crimson = stimulation.
Green = irritation.
Violet = depression.

IPECACUANHA.

Ipecacuanha is the dried root of *Cephælis Ipecacuanha,* a perennial herb native to Brazil.

Pharmacodynamics.

Central Nervous System.—No direct action known. In frogs a central paralysis is produced; in animals, a depression of the motor side of the cord.

Muscular System.—Weakened secondarily.

Respiration.—No effect.

Heart is slightly slowed, either reflexly or by direct action.

Blood-pressure is lowered in large doses from splanchnic relaxation, whether centric or reflex is uncertain.

Alimentary Tract.—Much irritated by local effect on mucosa.

Secretory glands are reflexly and directly stimulated. The gastro-intestinal glands are made more active.

Metabolism.—No effect.

Temperature.—Unchanged.

Absorption is very slow, even when retained.

Excretion is *via* kidneys and gastro-intestinal mucosa.

Local Action.—Irritant.

Symptoms.

Small Doses.	*Large Doses.*
Increased secretion of intestinal and bronchial glands.	Copious secretion of saliva.
Moderate diaphoresis.	Nausea.
	Vomiting.
	Usually no depression unless dose is so large as to cause repeated vomiting.

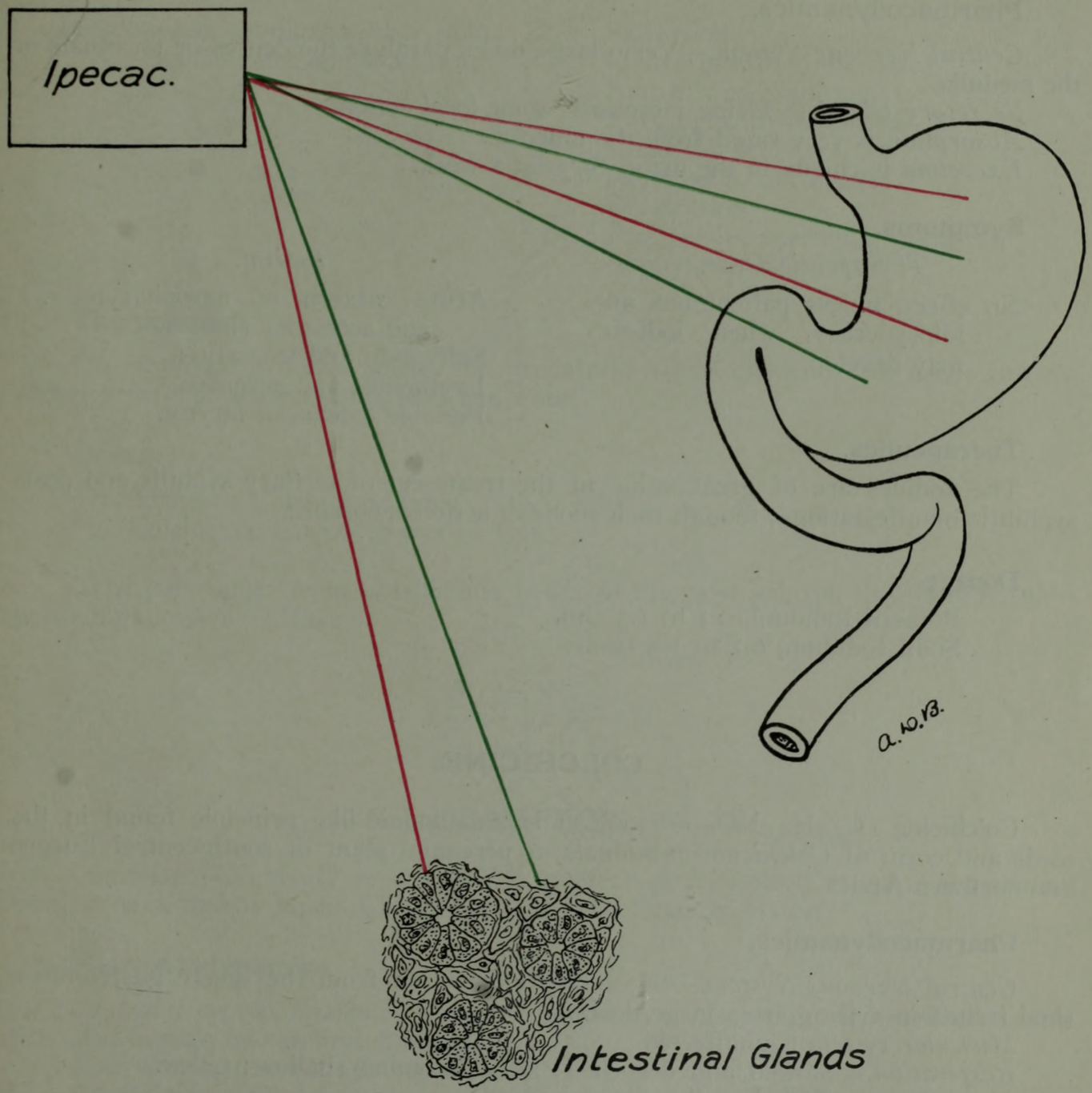
Therapeutics.

Ipecac is used in small doses as an antiemetic, a diaphoretic, and expectorant. In larger doses it becomes a very satisfactory emetic. In still larger doses, sometimes combined with laudanum to lessen or prevent vomiting, it is used as a specific in amœbic dysentery. Lately, its active principle, emetine, has been recommended for hypodermic use.

Dosage.

	Antiemetic	Expectorant	Emetic	Dysentery
Pulvis Ipecacuanhæ ...	0.008 Gm.	0.06 Gm.	1 Gm.	2 to 4 Gm.
Syrupus " ...	.....	1 mil	15 mils	.....
Fluidextractum " ..	.....	0.05 mil	1 mil	.....

Pulvis Ipecacuanhæ et Opii (each 10%), 0.5 Gm.



Crimson = stimulation.
Green = irritation

IODIDES.

The Iodides are the iodine salts of the alkali metals.

Pharmacodynamics.

Central Nervous System.—Very large doses paralyze the depressor terminals in the medulla.
Secretory Glands.—Urine increased; some local action.
Absorption is very rapid from the mucosa.
Excretion is chiefly in the urine, 85% in a week.

Symptoms.

Therapeutic Dose.	*Iodism.*
No effect, unless patient has an idiosyncrasy, when iodism may develop.	Acute catarrh of nasopharynx and accessory sinuses. Salivation and stomatitis. Erythemas and eczemas. Possible œdema of larynx.

Therapeutics.

The Iodides are of great value in the treatment of tertiary syphilis and post-syphilitic manifestations; though their mode of action is obscure.

Dosage.

Potassii Iodidum, 0.1 to 1.3 Gm.
Sodii Iodidum, 0.1 to 1.3 Gm.

COLCHICINE.

Colchicine ($C_{22}H_{25}NO_6 = 396.23$) is an alkaloid-like principle found in the seeds and corm of *Colchicum autumnale,* a perennial plant of south-central Europe and northern Africa.

Pharmacodynamics.

Central Nervous System.—Secondary exhaustion from the severe gastro-intestinal irritation arising from large doses.
Muscular system is unaffected.
Respiration.—Slowed and deepened; later becoming shallow; reflex.
Heart is not affected until collapse impends.
Blood-pressure not altered until late; then secondary.
Alimentary Tract.—The mucosa is intensely irritated by colchicum. This irritation rapidly induces a condition of systemic collapse similar to that produced in cholera.
Secretory Glands.—Not affected directly.
Metabolism.—No conclusive data.
Temperature.—Not affected.
Absorption is fairly rapid.
Excretion.—Uncertain.
Local Action.—Very irritating, producing redness and tickling.

COLCHICINE (*continued*).

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Seldom any symptoms other than possible colic and diarrhea.	Salivation. Gastro-intestinal distress. Nausea and vomiting. Purging with tenesmus. Great thirst. Depression and apathy. Prostration. Progressive ascending paralysis. Asphyxiation.

Therapeutics.

On empirical grounds solely, the preparations of Colchicum are used with asserted benefit in acute rheumatism and gout.

Dosage.

Tinctura Colchici Seminis, 1 to 2 mils.
Colchicina, 0.0006 to 0.0012 Gm.

"The poisoning (from Colchicum) is one of the most painful, slow, and hopeless poisonings known" (Hare).

CAMPHOR.

Camphor ($C_{10}H_{16}O$ = 150.98) is a stearopten derived from *Cinnamomum Camphora,* a tree of Japan, China, Formosa, and Eastern Africa.

Pharmacodynamics.

Central Nervous System.—Camphor produces a descending depression, possibly preceded in man by cerebral stimulation.
Muscular system not affected directly.
Respiration.—Slightly slower and deeper from centric action.
Heart.—Sometimes slightly slower; centric action.
Blood-pressure.—Slight fall, due to vasodilator action.
Alimentary tract is mildly irritated.
Secretory Glands.—Mildly stimulating.
Metabolism.—Camphor indirectly stimulates the leucocytes.
Temperature is lowered in fever; mode of action is uncertain.
Absorption is rapid from the stomach.
Excretion.—Camphor is oxidized in the tissues and eliminated in the urine in a combination with glycuronic acid.
Local Action.—Camphor is slightly irritant to nerves of sensation and pain.

CAMPHOR (*continued*).

Symptoms.

Medicinal Dose.	*Large Doses.*	*Toxic Doses.*
Hot, bitter taste.	Headache, confusion.	Drowsiness.
Warm sensation in stomach.	Excitement.	Unconsciousness.
Feeling of comfort.	Slowing of pulse.	Stupor.
	Nausea and vomiting.	Respiratory failure.
	Flushing of skin.	
	Hallucinations.	
	Deliria.	
	Stupor.	
	Unconsciousness.	

Therapeutics.

Camphor was formerly much used as an antispasmodic and nerve sedative. Its principal use today is for counterirritation, giving best results when made up in strong (50%) alcoholic solutions. For tender skins a 10% solution in oil may be used.

Dosage.

Spiritus Camphoræ (10%), 0.3 to 2 mils.

PHOSPHORUS.

Phosphorus (P = 30.77) is a non-metallic element, usually obtained from bones and certain minerals.

Pharmacodynamics.

Central Nervous System.—Little changed.

Muscular System.—Not affected except by the general tendency to fatty degeneration.

Respiration.—No known effect.

Heart.—Not affected, except in toxic doses.

Blood-pressure doesn't seem to be affected in any way.

Alimentary Tract.—Phosphorus induces a fatty infiltration of the epithelial cells, with sequent intercellular fibrosis. Bile salts are decreased; bile pigments increased at first, but later decreased; glycogen and lecithin reduced; increase of autolytic ferment.

Secretory Glands.—Fatty degeneration of the epithelium of the kidney.

Metabolism.—Phosphorus is a stimulant to the production of osteoblasts and of erythrocytes. It increases katabolism, especially of the liver, where a fatty infiltration soon ensues followed by intercellular fibrosis.

Temperature varies, sometimes rising, sometimes falling.

Absorption.—Phosphorus is absorbed with great difficulty, except when in a state of minute subdivision.

Excretion is obscure; some by kidneys, and some by the lungs.

Local Action.—May ignite and produce bad burns.

PHOSPHORUS (*continued*).

Symptoms.

Medicinal Doses.

No symptoms other than garlicky eructations.

Chronic Intoxication.

Cachexia.
Slight jaundice.
Anæmia.
Albuminuria.
Chronic enteritis.
Necrosis of mandible.
Cirrhosis of stomach, liver and kidney.

Acute Toxic Doses.

After several hours appear:
Gastric pain.
Nausea and garlicky eructations.
Bilious vomiting. (Diarrhea.)
Apparent recovery, then after several days, a recurrence of above symptoms, plus
Gastric and hepatic tenderness.
Jaundice and bloody vomitus.
Physical malaise; weak pulse.
Lessened urine, casts, and blood.
Subcutaneous hemorrhages.
Exhaustion, collapse, coma, and death.
General fatty degeneration.

Therapeutics.

Phosphorus seems to be logically indicated in disturbances of bone development.

Dosage.

Pilulæ Phosphori, 1 pill. (Each pill contains of phosphorus, 0.0006 Gm.)

ARSENIC.

Arsenic (As = 74.4) is a metal usually found in combination with cobalt, tin, and copper ores.

Pharmacodynamics.

Central Nervous System.—Peripheral neuritis and secondary cord degeneration in chronic poisoning. In other cases there are "no certain indications of direct action."

Muscular System.—Secondary fatty degeneration.

Respiration slackens in toxic doses from low blood-pressure.

Heart weakens in toxic doses from direct action.

Blood-pressure falls in toxic doses from direct action on muscle coat of arterioles, especially of the splanchnic area.

Alimentary Tract.—Arsenic produces an irritation of the mucosa, extreme dilatation of the intestinal capillaries, and a specific fatty degeneration of the gastro-intestinal epithelium.

Secretory Glands.—Little affected.

ARSENIC (*continued*).

Pharmacodynamics (*continued*).

Metabolism.—Arsenic produces a stimulation of the blood-forming organs; reduces the relative alkalinity of the blood; inhibits the glycogenic function of the liver; and produces a tendency to fatty degeneration of the epithelium of the intestine and of the lung alveoli, of the liver, kidney, muscle-cells of the heart and blood-vessels, and of striated muscle.

Temperature is sometimes elevated because of the inflamed mucosa.

Absorption is fairly rapid from mucosa under favorable conditions.

Excretion.—Arsenic is excreted chiefly by the kidneys, but elimination is slow, as it forms nuclein compounds in the tissues.

Local Action.—Irritant and escharotic if skin be broken.

Tolerance to the oral ingestion of arsenic is acquirable, presumably because the intestines no longer absorb it.

Symptoms.

Medicinal Doses.

No symptoms; if bagging under eyes appears, drug should be discontinued for a while.

Acute Poisoning.

Dysphagia; gastric pain.
Abdominal distress; colic.
Vomiting; serous diarrhea.
Giddiness, headache, cramps.
Pallor.
Weak, feeble pulse.
Sighing respiration.
Collapse; coma.
Death in 24 to 96 hours.

Chronic Poisoning.

1st Stage:

Weakness and lassitude.
Bagging under eyes.
Lachrymation. Anorexia.
Nausea; possibly vomiting.
Gastric discomfort.

2d Stage:

Catarrh of eyes, nose, and throat
Jaundice; hepatic swelling.
Exanthems; desquamation.
Melanosis and herpes.

3d Stage:

Persistent headache.
Acute localized pains.
Formication of extremities.
Erythromelalgia; myalgia.
Sensory peripheral neuritis.
Motor neuritis of extensors of extremities.
Symmetrical atrophy.
Mental apathy.

Therapeutics.

Arsenic is almost specific in chorea minor, is helpful in some forms of skin diseases, and has wrought striking cures in trypanosomiasis and in chronic syphilis.

Dosage.

Arseni Trioxidum, 0.001 to 0.005 Gm.
Liquor Potassii Arsenitis, 0.05 to 0.5 mil.

Arsphenamin or Salvarsan (paradiamidodioxyarsenobenzolum hydrochloride) contains 35% Arsenic, 0.6 Gm.

MERCURY.

Mercury (Hg = 198.5) is a metal obtained by roasting the native sulphids. Mined in the Americas, Spain, Japan, and Australia.

Pharmacodynamics.

Central Nervous System.—Higher centers are involved obscurely in chronic poisoning, the reflex excitability of the cord being also heightened. Peripheral neuritis often appears, though late.

Muscular system is not affected directly.

Respiratory system shows no direct effects.

Heart seems not affected except in acute poisoning from overwhelming doses, when heart is weakened by direct action.

Blood-pressure falls, in overwhelming doses, as a result of peripheral dilatation; probably a local action.

Alimentary Tract.—Mercury markedly irritates the mucosa of the (stomach) cæcum and colon. Does not directly increase the bile flow.

Secretory Glands.—Secretory apparatus of parotids greatly stimulated.

Kidney.—Marked irritation of secreting epithelium of tubules.

Metabolism.—Mercury lessens the alkalinity of the blood, and is thought to stimulate nutrition and leucocytosis.

Temperature.—No direct effect.

Absorption takes place readily, probably as an albuminate.

Excretion takes place by all the emunctories, but chiefly by the intestines and kidneys. It begins within an hour after the drug is taken, but continues very slowly.

Local Action.—Irritant, becoming escharotic.

Symptoms.

Medicinal Dose.

Stool in 8 to 10 hours.
Slight mental depression.
Some symptoms of acute poisoning in some patients.

Acute Poisoning.

Burning pain in stomach.
(Salivation).
Nausea and vomiting.
Diarrhea; bloody stools.
Violent tenesmus.
Thready, irregular pulse.
Shallow, rapid respiration.
Cold, clammy perspiration.
Pinched features, sunken eyes.
Anuria, usually.
Collapse.
Early death from shock, or in several days from exhaustion.

Chronic Poisoning.

Metallic taste, fetid breath.
Swollen, thickly-coated tongue.
Soft, swollen, bluish gums.
Salivation and stomatitis.
Loosening of teeth, and caries of jaw may ensue.
Anorexia, gastritis.
Lassitude, diarrhea and colic.
Small, weak pulse.
Anæmic cachexia.
Depression of nervous system.

Therapeutics.

Mercury is very often specific in the second stage of syphilis. Calomel, in small doses, is valuable in putrefactive diarrhea. Mercurial ointment is used in some chronic skin troubles.

Dosage.

Hydrargyri Chloridum Corrosivum, 0.002 to 0.004 Gm.
Hydrargyri Chloridum Mite, 0.008 to 0.03 Gm.

IRON.

Iron (Fe = 55.5) is found widely distributed in nature, but its principal native form is that of the oxide. It is an important constituent of the blood and other animal tissues, and of many vegetable substances.

Pharmacodynamics.

Central Nervous System.—No direct action known.
Muscular System.—No direct action known.
Respiration.—No direct action known.
Heart.—No direct action known.
Blood-pressure.—No direct action known.
Alimentary Tract.—Mildly irritant.
Secretory Glands.—No action.
Metabolism.—Iron must exert some profound influence, inasmuch as a deficiency of this element is accompanied by very grave symptoms; but the mechanics of its action is quite unknown, except for the physiology of hematin as an oxygen carrier.
Temperature.—No action.
Absorption.—Iron is slowly absorbed in minute quantities, either in metallic form or in solution. It is taken up by the epithelium of the duodenum, carried thence to the spleen, then to the liver, where it is utilized slowly by the blood.
Excretion takes place through the cæcum and colon.
Local Action.—None.

Symptoms.

Therapeutic Doses.

Astringent metallic taste.

Prolonged Use.

Some dyspepsia.
Constipation.
Blackening of the teeth.
Hyperacidity of the stomach.

Large Doses.

Gastric uneasiness.
Nausea and vomiting.
Intestinal irritation.
Fullness in the head.

Therapeutics.

Iron is a specific in a large proportion of cases of chlorosis.
Of all the official preparations of iron two only need be mentioned, the carbonate and the citrate.

Dosage.

Pilulæ Ferri Carbonatis, 1 pill = 0.06 Gm.
Ferri Citras, 0.12 to 0.3 Gm.

NOTE.—Because of its deleterious influence on the teeth, Tinctura Ferri Chloridi ought to be proscribed, never prescribed.

LEAD.

Lead (Pb = 205.35) is an element occurring largely in ores in the form of the sulphide. Found chiefly in the upper Mississippi valley.

Pharmacodynamics.

Central Nervous System.—Lead is irritant to the brain-cells, to the nerves, and to the cells of the cord, especially those of the anterior column. Cell degeneration frequently ensues.

Muscular System.—Obscure alterations in unstriped muscle.

Respiration not affected.

Heart is slowed reflexly in intoxications.

Blood-pressure may be raised at times by vasoconstrictor irritation.

Eye.—Lead is irritant to the retinal cells and to the optic nerve, tending to produce degenerative changes.

Alimentary Tract.—Lead is irritant to mucosa, and to the vasomotor terminals.

Secretory Glands.—Lead is decidedly irritant to the kidney cells, tending to induce parenchymatous and interstitial degenerations.

Metabolism.—Lead induces a debilitated condition of the red blood-corpuscles, and brings on in an obscure way a pronounced disturbance of the trophic system.

Temperature.—No effect.

Absorption.—Lead is absorbed rapidly, and remains lodged in the tissues for a long time.

Excretion.—Urine chiefly; also in milk and saliva, and in epithelial glands.

Local Effect.—Protective through formation of pellicle of lead albuminate.

Symptoms.

Therapeutic Dose.

Sweetish, metallic taste.
Astringent after-taste.
Constipation.

Acute Poisoning.

Nausea and vomiting.
Abdominal pain.
Bloody purging.
Great thirst, weakness.
Acute gastro-enteritis.
May lapse into chronic type.
May cause death from exhaustion.

Chronic Poisoning.

Anorexia, constant metallic taste.
Fetid breath. Bluish-black gums.
Nausea. Obstinate constipation.
Anæmia from erythrolysis.
Acute, intermittent colic.
Paralysis of forearm extensors.
Contractures of flexors, caused by peripheral neuritis.
Local, intermittent anæsthesias.
Amblyopia from retinitis.
Cerebral irritations, choreas, tremors, depressions, manias.
Nephritis, gout.
Arteriosclerosis.

Therapeutics.

Lead is administered for its astringent effect in diarrheas, but could well be discarded entirely as a medicinal agent.

Dosage.

Plumbi Acetas, 0.05 to 0.3 Gm.

MALE FERN (Aspidium).

Male Fern is the dried root of *Dryopteris filix-mas*, or *Dryopteris marginalis*, perennial herbs of the north temperate zone, and mountainous regions of the tropics.

Pharmacodynamics.

Central Nervous System.—Male Fern depresses the upper centers, and stimulates the reflex excitability of the cord.
Muscular System.—No direct action.
Respiration depressed by centric action.
Heart is depressed by centric action.
Blood-pressure.—Falls with decreased heart-action.
Alimentary Canal.—Irritant.
Secretory Glands.—No effect.
Metabolism.—Male fern destroys red blood-corpuscles.
Temperature.—No effect.
Absorption is very slow, so that the accompanying purge usually sweeps the drug out before constitutional symptoms develop. Some subjects are susceptible to its action, and may be acutely poisoned. Its absorption is facilitated by the presence of oils.
Excretion.—Nothing seems definitely known about the elimination of Aspidium.
Local Action.—None.
Eye.—Filix-mas sometimes induces a neuritis of the optic nerve.

Symptoms.

Therapeutic Doses.	*Too Large Doses.*
Usually no symptoms, but may produce results very alarming.	Vomiting and purging. Acute colic. Muscular weakness. Mental confusion. Drowsiness. Collapse, coma, and death.

Therapeutics.

Male Fern is used for the expulsion of the tapeworm. It is given after a fast, and should be followed in eight hours by a saline purge. Castor oil, or any other kind of oil, should not be used for a purge following Aspidium.

Dosage.

Oleoresina Aspidii, 2 Gm.
Not to be repeated within seven days.

Thymol is used to expel hookworm. It is given, after ten hours fasting, in doses of 0.75 Gm., repeated twice at 15-minute intervals. Four hours later a brisk *saline* purge is given. Oil of any kind must not be allowed the patient, as it renders the thymol freely absorbable, resulting in alarming poisoning with weakness, apathy, and collapse.

SANTONIN.

Santonin ($C_{15}H_{18}O_3 = 244.29$) is the lactone of santonic acid, derived from the flower heads of Levant Wormseed (*Artemisia pauciflora*), a plant of Northern Turkestan and Russia.

Pharmacodynamics.

Central Nervous System.—Santonin is an irritating stimulant of the cortex and basal ganglia, and later of the synapses of the spinal cord.

Muscular System.—No direct action known.

Respiration is not altered until late, when asphyxia ensues from centric action.

Heart.—No alteration.

Blood-pressure.—No effect except in late acute poisoning, when there is a reflex fall from general collapse.

Eye.—Santonin alters the violet-sensitive substance in the retina, a xanthopsia resulting.

Alimentary Tract.—Mildly irritant.

Secretory glands are apparently not affected.

Metabolism.—No constant change noted.

Temperature not affected.

Absorption is very prompt by both stomach and intestines.

Local Action.—None.

Symptoms.

Therapeutic Doses.	*Toxic Doses.*
Slightly bitter taste.	Unilateral twitching of head muscles.
Disturbance of color sense, violets being diminished and yellows accentuated.	Rolling of eyes.
	Grinding of teeth.
	Nausea and vomiting.
	Confusion. Possible aphasia.
	Epileptiform convulsions.
	Coma and asphyxia.

Therapeutics.

Santonin is used for the expulsion of the round worm, Ascaris lumbricoides. The diet should be much restricted for the preceding 24 hours. Four hours after administering the drug, a full dose of castor oil should be given.

Dosage.

Santoninum, 0.03 to 0.1 Gm.

Trochisci Santonini, each contains 0.03 Gm. Santonin.

Quassia.—Infusions of Quassia are used to free the lower bowel of threadworms, being used in the form of enemata. It probably acts by stupefying the parasite.

INORGANIC SALTS.

Sodium Chloride, in dilute solution, causes the tissues to become swollen and softened; whereas, in concentrated solutions, it tends to extract water from the tissues. Consequently, the red blood-corpuscles become swollen when in hypotonic solutions, and shrink in hypertonic solutions. This same characteristic action of sodium chloride on muscle tends to injure the vitality of the muscle-cell, and on mucous membranes tends to interfere with function. The blood is concentrated by hypertonic solutions, and made more liquid by hypotonic solutions, though in either case normal conditions are soon restored by osmosis of tissue-lymph.

Salt solutions in the blood augment the flow of urine through increased capillary pressure in the glomerulus.

Salt solution, in the isotonic form, 0.9%, is used chiefly to compensate for loss of blood, as in hemorrhages and in cholera; and for flushing the system in uræmia.

Potassium Chloride depresses the central nervous system, especially the great centers in the medulla; it also has a toxic action on the heart.

Potassium Salts are not to be administered for the potassium effect, as this effect is not elicited when the drug is given by stomach.

Ammonium Chloride, when injected subcutaneously or intravenously, stimulates the central nervous system in the same manner as strychnine, but this action is not elicited by oral administration. When given by mouth, it is absorbed readily by the stomach and intestines, and has been thought to stimulate the mucosa of the stomach and intestines. In the bronchi, however, application must be made direct, as the epithelium of the lungs is impermeable to the ammonium ion.

Ammonium chloride is thought to be good for gastric catarrh; and, in the form of nascent vapor, is used for bronchitis.

Ammonia Gas, when inhaled, irritates the nasal and bronchial mucosa, producing thereby a reflex stimulation of the vasomotor center, with a resulting vasoconstrictor action and a temporary rise in blood-pressure. It is thus of value in syncope. The inhalation is dangerous in higher concentration than 1 : 2000.

Ammonium Carbonate is a mild irritant to the stomach. When given in solution it is thought to be of value in the treatment of flatulency.

The ammonia vapor from the carbonate is used in "smelling salts" for its reflex stimulation. It is probably of some use in impending attacks of faintness.

Ammonia salts are rapidly excreted.

HYDRATES and CARBONATES of the ALKALIES.

The pharmacodynamics of this group is due entirely to the non-metallic ion.

These substances have a soapy, detergent feeling in the mouth; are neutralized in the stomach, unless in large quantities; are absorbed rapidly from the intestines, as carbonates or in combination with proteins; increase the relative alkalinity of the blood; and are promptly excreted as alkaline salts from the kidney.

Concentrated solutions are strongly escharotic; especially is this true of the hydrates.

HYDRATES and CARBONATES of the ALKALIES (*continued*).

Therapeutics.

The Hydrates and Carbonates are used in weak solutions as antacids, affecting the alimentary tract, the blood, and the urine.

The most satisfactory drug of this class is sodium bicarbonate.

Dosage.

Sodii Bicarbonas, 0.5 to 2 Gm.

Calcium salts are absorbed very slowly, and in minute quantities. They have no obvious action except in cases showing deficiencies of lime. As an antacid, lime is inferior to sodium bicarbonate, because of its interference with digestive processes.

Calcium is an essential element in the blood for maintaining normal cardiac rhythmicity, and for the development of fibrin ferment; it is also essential to normal bone-growth.

Calcium is excreted by the epithelium of the large intestine.

Therapeutics.—The only condition where lime is positively known to have been of benefit is in cases of tetany.

INTERNAL SECRETIONS.

Thyroid Extract is derived from the dried thyroid glands of sheep.

Pharmacodynamics.

Elicited by large doses.

Central Nervous System.—Obscure irritations of the higher centers, the medulla, and the anterior columns of the cord.

Muscular System.—Efficiency lowered, probably reflexly.

Respiration.—No effect.

Heart accelerated and weakened; centric. An inconstant result.

Blood-pressure lowered; probably as a reflex.

Alimentary tract is irritated.

Secretory Glands.—Kidney epithelium lowered in vitality.

Metabolism.—Thyroid increases protein waste, fat oxidation, fluid elimination, nitrogen and phosphorus excretion, and modifies to some extent the metabolism of carbohydrates.

Excretion.—A part of the contained iodine is excreted in the urine in the form of iodides.

Symptoms.

Cranial congestion, acceleration and palpitation of the heart, muscular weakness, tremors, diarrhea, increased urine, thirst, loss of weight.

Therapeutics.

Thyroid seems specific in some forms of sporadic cretinism. It is also of benefit in cachexia thyreopriva, and sometimes in some types of myxœdema.

Dosage.

Thyroideum Siccum, 0.2 Gm.

INTERNAL SECRETIONS (*continued*).

The **Thymus Gland,** derived from sheep, produces an acceleration of pulse, from direct action on the heart; and a fall in blood-pressure, from paralysis of the vasoconstrictors.

Therapeutics.—It has been used for exophthalmic goiter, but not with encouraging success.

The **Pituitary Body** (extracts of the pars intermedia) causes a slowing of the heart, from both centric inhibition and local action; and a rise in blood-pressure from stimulation of the vasoconstrictor fibers. It also causes, by local action, a contraction of the muscles of all vessels and organs, except in the kidney, where there is produced a dilatation of the vessels, with a great increase of urine.

Therapeutics.—Not as yet satisfactorily developed, though used with much apparent success in obstetrics. Liquor Hypophysis, 1 mil.

Ovarian Extract does not seem to have yielded any pharmacological data, as yet. It has been used with more or less success in combating the nervous and nutritional disturbances accompanying the normal or artificial menopause.

FERMENTS.

Pepsin is a ferment derived from the stomach of the pig.

Its sole known action is that of proteolysis, acting in an acid medium only.

Its use is indicated in those rare conditions where there is known absence of pepsin in the gastric secretion.

Dose.—Pepsinum, 0.2 to 0.6 Gm.

Pancreatin is obtained from the fresh pancreas of the pig.

Pancreatin acts in an alkaline medium. It splits proteins, converts starches to sugars, and saponifies and emulsifies fats.

It can be used for its digestive properties, but is quickly rendered inert by a short exposure to acid gastric juice. Its chief medicinal value is obtained when used to predigest food for weak invalids, and to split the proteins of nutrient enemata, so they are more readily absorbable by the rectal mucosa.

Dose.—Pancreatinum, 0.5 Gm.

BILE.

Bile is obtained from the ox. When administered by mouth, bile is absorbed from the stomach and intestines and carried to the liver, where it stimulates the secretion of both the liquid and solid constituents of bile.

Bile might, therefore, be used as a cholagogue if any indication for such use were known.

Dose.—Extractum Fellis Bovis, 0.1 Gm.

SERUMS.

Antidiphtheric Serum is derived from the blood of a horse in which high immunity has been produced by a succession of gradually increasing doses of diphtheria toxin. This immunity is the result of the development of some substance termed antitoxin.

The antitoxins are efficient through neutralization of the toxins generated by the diphtheria bacilli. The serum produces no symptoms due to the antitoxin; but erythemas, fever and fleeting pains sometimes occur as a result of inevitably-retained anaphylactic substances.

Therapeutics.—The serum is specific in diphtheria if used early, and in sufficient amount.

Dose.—Prophylactic, 1000 units; combative, 10,000 units, repeated.

(A unit is the amount necessary to protect a 250-Gm. guinea-pig against 100 times the fatal dose of toxin.)

Antitetanus Serum is derived from immunized horse serum. It is used to counteract the toxin of tetanus, and seems to act more efficiently as a preventive than as a curative.

Dose.—One thousand units; repeated as necessary.

Typhoid Vaccine has given remarkable results in the army as a preventive of enteric fever.

ANTISEPTICS, DISINFECTANTS and GERMICIDES.

Acidum Boricum is a feeble deterrent of germ growth. It is advantageously employed as a collyrium and in douches.

Aqua Hydrogenii Dioxidi is a useful disinfectant on surfaces and in freely flushable cavities. It acts through disengagement of free oxygen.

Oleum Eucalypti is a mild inhibitor of germ growth. Its use as a spray is thought to lessen scarlatina complications.

Cupri Sulphas, 1-1 million, is used to destroy algæ in the reservoirs of drinking water.

Argenti Nitras (0.5% sol.) is a valuable antiseptic and gonorrheal prophylactic when used (once only) as a collyrium in new-born infants. It acts by coagulating albumin.

Balsamum Peruvianum is an efficient germicide in pediculosis pubis; and a mild antiseptic and stimulant in sluggish granulations.

Cresol is an antiseptic of the phenol series, acting by precipitation of protein.

Liquor Formaldehydi is a powerful germicide and disinfectant, acting, presumably, by uniting with the amino group in the proteins of the microbes.

Hexamethylenamina is a urinary antiseptic, acting through the formaldehyde liberated.

Phenol is germicide and disinfectant, being a poison to all protoplasm.

CATHARTICS and PURGES.

Purgative Oils.

Castor Oil is decomposed in the small intestine, and the resulting ricinolates are so irritant as to induce increased secretion and peristalsis.

Castor oil is used as a broom to sweep putrefactive masses out of the intestines.

Dose.—Oleum Ricini, 4 to 30 mils.

Croton Oil is similarly decomposed in the small intestine into glycerin and crotonoleic acid and a resinous anhydride which latter is *very* irritant.

Croton oil is used in emergencies, or as a drastic purge to relieve cerebral congestion.

Dose.—Oleum Tiglii, 0.02 to 0.05 mil.

Anthracene Purgatives.

Rhubarb probably irritates the mucosa of the jejunum and ileum. It is useful in fermentative diarrheas.

Dose.—Tinctura Rhei Aromatica, 2 mils.

Senna mildly stimulates the whole small intestine. It is useful as a simple cathartic for children.

Dose.—Tinctura Sennæ Composita, 8 to 15 mils.

Aloes is said to stimulate the mucosa of the sigmoid and rectum. It is useful as a *temporary* measure in depressed peristalsis of the lower bowel.

Dose.—Aloes, 0.25 Gm.

Cascara is said to increase secretion into the rectum. It is the one safe drug to use in chronic constipation of the simple type characterized by hard infrequent stools.

Dose.—Fluidextractum Cascaræ Sagradæ Aromaticum, 1 mil, much diluted with water.

Resinous Glucosides.

These act by irritating the mucosa, sometimes producing inflammatory exudates. The seat of action is chiefly the small intestine, and the presence of bile seems essential.

The resinous glucosides are used to clear out the bowel, especially in those encumbered conditions due to overeating.

Dosage.—Resina Podophylli, 0.005 to 0.03 Gm.; Resina Jalapæ, 0.1 to 0.3 Gm.

Salines.

The saline cathartics act by increasing the fluidity of the intestinal contents thereby stimulating peristalsis. This increased fluidity is due to a retardation of absorption produced by the salines and to an exosmosis caused by the hypertonicity of the salts.

Salines are useful whenever a quickly-acting, non-irritating flushing out of the bowels seems desirable.

Dosage.—Magnesii Sulphas, 2 to 30 Gm.; Sodii Phosphas, 2 to 30 Gm.; Pulvis Effervescens Compositus, 1 powder.

MISCELLANEOUS PREPARATIONS.

Demulcents are used for their action in coating inflamed mucous surfaces, thereby protecting from irritation.

For the throat, Mucilago Ulmi.

For the stomach and bowels: Emulsum Amygdalæ, Bismuth.

Emollients are bland substances applied to the skin. Examples: Adeps lanæ, Petrolatum, Glyceritum.

Counterirritants inflame the skin and act reflexly by heightening sensibility in that region of the cord receiving the sensory fibers irritated, and thereby affecting the condition of all parts supplied by such nerves as have synapses in that same region of the cord.

Mild rubefacient: Spiritus Camphoræ, 50%.

Strong rubefacient: Oleum Terebinthinæ Rectificatum.

Rubefacient and occasional vesicant: Tinctura Iodi; also Sinapis Alba.

Astringents.—Vegetable astringents used to be largely employed for checking diarrheas; but modern treatment aims now at the cause, so the use of these astringents has nearly been abandoned.

Mineral astringents are employed for their effect in coagulating albumins.

Examples are: Alumen, Argenti Nitras, Cupri Sulphas.

Carminatives are substances used to relieve flatulency and gastro-intestinal unrest. They act through their mild irritation on the mucosa, increasing blood-supply and stimulating secretion.

Tinctura Cinnamomi, 2 to 4 mils.

Spiritus Menthæ Piperitæ, 0.6 to 2 mils.

Spiritus Gaultheriæ, 0.6 to 2 mils.

Protectives are substance which, by coating a surface with a relatively permanent and insoluble pellicle, exclude air, water, and other irritating material.

Examples: Collodium, Tinctura Benzoini, Zinci Stearas.

REMEDIAL MEASURES OTHER THAN DRUGS.

The application of *cold* is used to modify congestion. It has a double action: (1) the abstraction of heat, and (2) a reflex counterirritancy. It is indicated in localized inflammations, and in high fever.

Cold bathing is stimulant to hardy individuals because of its causing a superficial vasoconstriction followed by vasodilatation, thereby hastening normal, healthful metabolism.

Lavage is a simple cleansing of the mucosa of the stomach

Enteroclysis is a temporary measure used to cause evacuations of the bowels, or to quickly supply a source of liquid renewal of the blood in case of hemorrhages.

Douches are used for the cleansing of body cavities, for the local application of medicaments, and for reflex effects.

Nutrient enemata are employed to supply nourishment to the system whenever the normal avenue is from any reason proscribed. All food should be predigested with pancreatin.

Heat is used to promote inflammatory action in restricted areas, to relax tissues, to hasten circulation and thereby accelerate metabolism, to stimulate the emunctory function of the skin by vasodilatation, and to act as a counterirritant.

Hypodermoclysis is the supplying of liquid to the blood-stream by infiltrating some subcutaneous tissue with normal salt solution, or preferably with Locke's solution.

Transfusion is the utilizing of another's blood to supply a deficiency, in quantity or constituents, in the blood of the patient.

Inhalations are of use as a convenient means of applying atomized medicaments to the respiratory tract, and of utilizing in the throat and bronchi the soothing relaxing effect of hot vapor.

Rest is a means of giving a part needed time for recuperation.

Gymnastics are useful in promoting more active metabolism by muscle movements. The stimulated circulation is accompanied by increased oxidation and augmented elimination of katabolic products.

Dieting is the scientific supplying to the body of just those food constituents, and in the form necessary for assimilation, that the body demands. Were correct dieting universally understood and applied more than half of our present illnesses would disappear.

Starving is a measure taken to give the body time to complete elimination of the accumulated waste in the tissues, and to adjust itself to the immediate metabolic requirements. It has produced what seem to be cures in diabetes, and is an excellent measure in plethoras of bowels, lungs, or circulation.

PHARMACODYNAMICS ACCORDING TO THE SEVERAL SYSTEMS.

Central Nervous System.

Cerebrum.

Stimulation.	*Depression.*
Caffeine	Alcohol
(Cannabis)	Cannabis
(Cocaine)	(Cocaine)
(Atropine)	Chloral
	Morphine
	Tobacco
	Atropine
	Antimony
	Quinine
	Bromides
	Ether
	Chloroform
	Camphor

Cerebellum.

Stimulation.	*Depression.*
Tobacco	Alcohol
(Cocaine)	Cocaine
	Morphine
	Ether
	Chloroform
	Antimony
	Atropine
	Bromides

Medulla.

Caffeine	Alcohol
Digitalis	Chloral
Aconite	Morphine
Strychnine	Cocaine
Santonin	Atropine
(Cocaine)	Pilocarpine
(Atropine)	Physostigmine
	Ether and Chlor.
	Veratrine
	Bromides
	Antimony
	Quinine

Spinal Cord.

Strychnine	Alcohol
Caffeine	Chloral
Morphine	Morphine
Veratrine	Cocaine
Acetphenetidin	Atropine
Aspidium	Pilocarpine
Santonin	Physostigmine
NH_4Cl (hypo.)	Ether and Chlor.
(Atropine)	Antimony
(Cocaine)	Bromides
	Quinine
	Lead

Muscular System.

Voluntary.

Stimulation.	*Depression.*
Caffeine	Tobacco
Veratrum	Physostigmin
	Aconite
	Antimony
	Quinine

Involuntary.

Stimulation.	*Depression.*
Strychnine	Atropine
Physostigmine	Antimony
Pilocarpine	Lead
Epinephrin	
Ergot	
Quinine	

Respiration.

Stimulation.	*Locus of action.*
Strychnine	Centric
Caffeine	Centric
Cocaine	Centric
Atropine	Centric
(Antimony)	Centric
(Quinine)	Centric

Depression.	*Locus of action.*
Chloral	Centric
Morphine	Centric
Cannabis	Centric
Pilocarpine	Local
Physostigmine	Centric
Ether and Chlor.	Centric
Veratrum	Centric
Antimony	Local
Bromides	Central
Acetphenetidin	Centric
Salicylic Acid	Centric
Colchicum	Reflex
Aspidium	Centric

Heart.

Stimulation.	
Caffeine	C.
Cocaine	L.
Atropine	L.
Epinephrin	L.
(Ergot)	L.
(Digitalis)	L.

Depression.	
(Caffeine)	L.
Chloral	L.
Morphine	C.
Tobacco	L.
Pilocarpine	L.
Physostig.	L.
Ether	L.
Chloroform	L.
Epinephrin	C.
Ergot	C. & L.
Digitalis	C.
Aconite	C. & L.
Veratrum	C.
Antimony	L.
Acetphenet.	L.
Ac. Salicyl.	L.
Aspidium	C.
Pituitary	C.

Blood-pressure.

Stimulation.	
Strychnine	C.
Caffeine	C.
Cocaine (1)	C.
Atropine	C.
Pilocarpine	L.
Physostig.	L.
Epinephrin	L.
Ergot	L.
Digitalis	C.
Ac. Salicyl.	L.
NH_4OH	R.
Pituitary	L.

Depression.	
Cocaine (2)	L.
Ether	L.
Chloroform	L.
Nitroglyc.	L.
Aconite	L. & C.
Veratrum	R.
Antimony	R.
Ipecac	L.
Aspidium	C.

Secretory Glands.

Stimulated.	
Apomorphine	C.
Pilocarpine	P.
Tobacco	P.
Physostig.	P.
Aconite	L.
Antimony	L.
Mercury	L.

Depressed.	
Morphine	C.
Tobacco	P.
Cocaine	C.
Atropine	L.
Lead	C.

Metabolism.

Increased.	*Diminished.*
Strychnine	Alcohol
Caffeine	Morphine
Chloral	Quinine
Atropine	
Veratrum	
Antimony	
Ac. Salicyl.	
Ipecac	
Phosphorus	
Thyroid	

Alimentary Tract.

Stimulation.	*Depression.*	*Irritation.*
Aloes	Aconite	Ac. Salicylic., Antimony
Caffeine	Alcohol	Arsenic, Bromides
Senna	Apomorphine	Castor oil, Colchicine
Strychnine	Chloral	Croton oil, Ipecac
	Digitalis	Lead, Mercury
		NH_4HCO_3, Rhubarb
		Veratrum, xanthracene purges.

Peristalsis.

Increased.	*Diminished.*
Cocaine (small)	Cocaine (large)
Pilocarpine	Atropine
Physostigmine	Epinephrin
Purges	Ergot
Salines	Opium
Veratrum	

Kidney.

Stimulated.	*Depressed.*
Caffeine	Quinine
Cocaine	Atropine
Ac. Salicylic.	
(Digitalis)	
Iodides	*Irritated.*
Ipecac	Mercury

Sweat Glands.

Stimulated.	*Depressed.*
Aconite	Atropine
Ac. Salicylic.	Bromides
Antimony	
Pilocarpine	
Physostigmine	
Veratrum	

Salivary Glands.

Stimulated.	*Depressed.*
Pilocarpine	Atropine
Physostigmine	
Aconitine	
Antimony	
Mercury	

Eye.

Pupil.

Contraction.	*Dilatation.*
Morphine, depression cerv. symp. (?)	Atropine, paralysis circularis.
Chloroform, depression cerv. symp.	Cannabis, depression 3d n. (?)
Ether, depression cerv. symp.	Cocaine, stimulation cerv. symp.
Ergot, stimulation 3d nerve.	Chloroform, depression 3d nerve.
Physostig., stimulation 3d nerve.	Ether, depression 3d nerve.
Pilocarpine, stimulation 3d nerve.	Epinephrin, stimulation cerv. symp.

TEMPERATURE.

Increased.

Atropine	C.

Diminished.

Ac. Salicylic.	C.
Acetphenetidin	C.
Aconite	C.
Alcohol	P.
Antimony	R.
Apomorphine	R.
Camphor	C. (?)
Chloral	C.
Digitalis	C.
Ether	S.
Chloroform	S.
Morphine	C. & P.
Pilocarpine	P.

ABSORPTION.

Rapid.

Aconite
Acetphenetidin
Ac. Salicylic.
Alcohol
Apomorphine
Arsenic
Atropine
Bromides
Caffeine
Chloral
Cocaine
Mercury
Iodides
Lead
Morphine
Physostigmine
Pilocarpine
Quinine
Santonin
Strychnine

Slow.

Aspidium
Antimony
Digitalis
Ipecac
Iron
Phosphorus

ELIMINATION.

Rapid.

Acetphenetidin
Caffeine

Slow.

Ac. Salicylic.
Antimony
Arsenic
Bromides
Digitalis
Iodides
Lead
Mercury
Quinine
Strychnine

EQUIVALENTS OF MEASURES OF LENGTH.

METRIC AND LINEAR MEASURE

Centimeters.	Inches.	Centimeters.	Inches.	Millimeters.	Inches.	
					in decimal fractions.	in 32ds.
150	59.06	55	21.65	25.4	1	32/32
145	57.09	53.3	21	25	0.98	..
140	55.12	50.8	20	24.0	0.94	..
139.7	55	50	19.69	23.8	0.94	30/32
135	53.15	48.3	19	23.0	0.91	29/32
130	51.18	45.7	18	22.2	0.87	28/32
127.0	50	45	17.72	22.0	0.87	..
125	49.21	43.2	17	21.0	0.83	..
120	47.24	40.6	16	20.6	0.81	26/32
115	45.28	40	15.75	20	0.79	..
114.3	45	38.1	15	19.1	0.75	24/32
110	43.31	35.6	14	19.0	0.75	..
105	41.34	35	13.78	18.0	0.71	..
101.6	40	33.0	13	17.5	0.69	22/32
100	39.37	30.5	12	17.0	0.67	..
99.1	39	30	11.81	16.0	0.63	..
96.5	38	27.9	11	15.9	0.62	20/32
95	37.40	25.4	10	15	0.59	..
94.0	37	25	9.84	14.3	0.56	18/32
91.4	36	22.9	9	14.0	0.55	..
90	35.43	20.3	8	13.0	0.51	..
88.9	35	20	7.87	12.7	0.50	16/32
86.4	34	17.8	7	12.0	0.47	..
85	33.46	15.2	6	11.1	0.44	14/32
83.8	33	15	5.91	11.0	0.43	..
81.3	32	12.7	5	10	0.39	..
80	31.50	10.2	4	9.5	0.38	12/32
78.7	31	10	3.94	9	0.35	..
76.2	30	9	3.54	8.7	0.34	11/32
75	29.53	8	3.15	8	0.31	..
73.7	29	7.6	3	7.9	0.31	10/32
71.1	28	7	2.76	7.1	0.28	9/32
70	27.56	6	2.36	7	0.28	..
68.6	27	5.1	2	6.4	0.25	8/32
66.0	26	5	1.97	6	0.24	..
65	25.59	4	1.57	5.6	0.22	7/32
63.5	25	3	1.18	5	0.20	..
61.0	24	2.54	1	4.8	0.19	6/32
60	23.62	2	0.78	4	0.16	..
58.4	23	1	0.39	3.2	0.13	4/32
55.9	22			3	0.12	..
				2.4	0.09	3/32
				2	0.08	..
				1.6	0.06	2/32
				1	0.04	..
				0.8	0.03	1/32
				0.1	0.0039	..

From the "United States Pharmacopœia," Eighth Edition.

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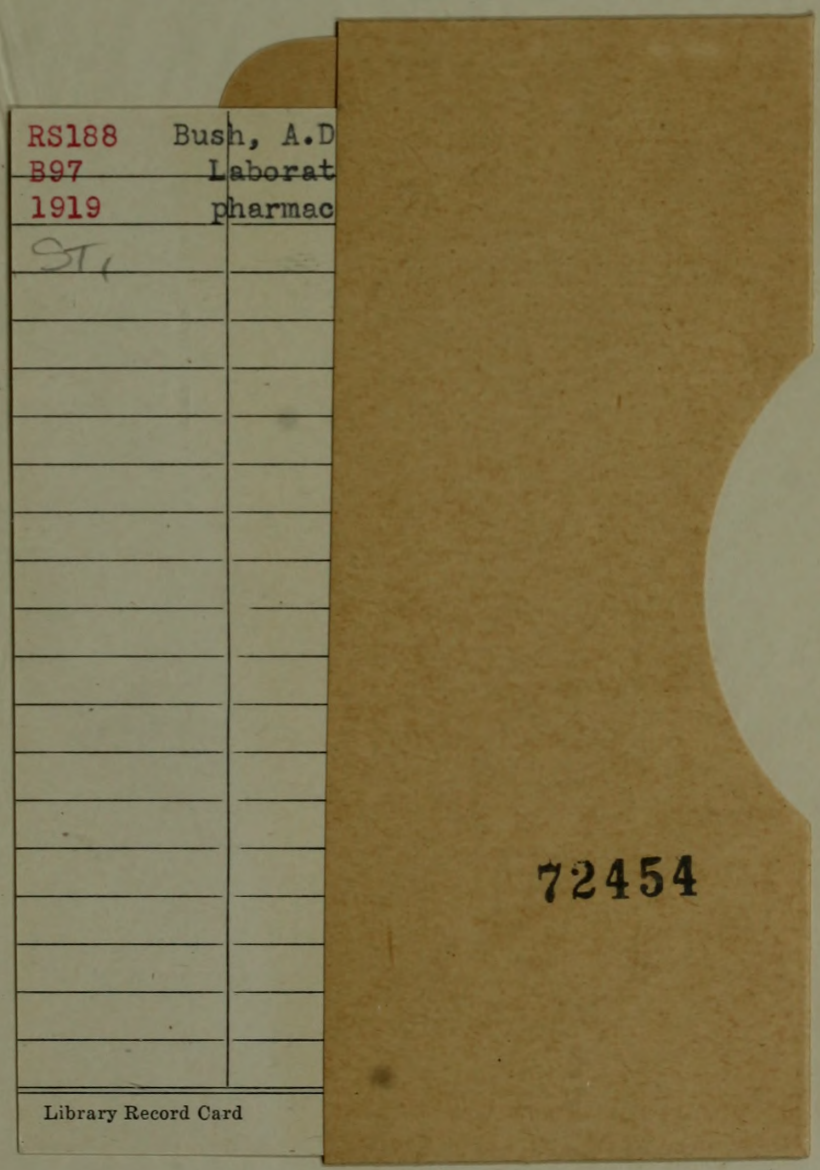
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